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ELECTRICAL WORLD AND ENGINEER.

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THE UNION ENGINEERING BUILDING.

Last week we were able to lay before our readers some of the details connected with the magnificent gift of one million dollars to build a home in this city for the four national engineering societies and the Engineers' Club. As will be seen from our pages this week, the news has been acted upon promptly by the great bodies affected, and, having thanked Mr. Carnegie in an informal but enthusiastic manner, they are now proceeding to give due official form and validity to acceptance by the entire membership.

No one event has ever meant quite so much to the engineering professions in America as this recognition of them by one who gladly admits that to them he owes much; and we can but believe that the course of events will thoroughly justify Mr. Carnegie in the trust he has laid upon his fellow-members and friends, and witness the creation of a great, noble, enduring and useful engineering center. The best proof of the impression made upon engineers in general and of their eager readiness to carry out the plan, is shown by the remarkable unanimity of the engineering press of the country. With but one exception and that due apparently to an utter want of comprehension of what has been given and what is intended, the technical press has united in praise of the movement and in urging upon the bodies and the individual members to be prompt in putting through the necessary plans for executing the project, so long a faint, vague hope but now destined to splendid realization.

That any society should fail to accept its share of the gift is dismissed by everybody as incredible. The possible exception would be the Civil Engineers, because they have a house of their own, and would naturally be loath to give it up. But the building they have is confessedly in some respects a failure. It is rather inaccessible and far away from the social and club center of the city. There is Mr. Gould's stable in front of it, ornate it is true, but hardly good company. The one large auditorium is a very poor place for meetings, with bad acoustics and susceptible of no change of size to accommodate varying audiences. The library is admirable, but to-day it does not and cannot represent engineering as will the federated libraries under the one roof of the union building, each section probably with its own staff and each having more money to spend on its legitimate specialties because of avoiding duplication. Besides, the great New York Public Library will be just across the way, and it is altogether fit and seemly that the joint engineering library should be near that literary heart of the city. Under all the circumstances, there is every reason why the Civil Engineers' Society should come in, and not one for staying out. If its members decide to go on alone, it will be a pity, but the plan will be carried out, of course, just the same, and under the terms of Mr. Carnegie's gift and his statements, the other bodies will have just that much more to spend for themselves and others.

We trust and believe that all branches of engineering will now be brought together for the specific purpose of erecting the building, and we would like to point out that every member in perhaps all of the societies will have an opportunity to prove his own generosity by gifts of money and service. Mr. Carnegie has made the whole thing the easiest in the world to execute by advancing also the money, without present interest, to finance the acquisition of the land by the four societies, but the American Institute of Electrical

Engineers, for example, will be all the better able to discharge its mission if it goes into the new home free of debt, meeting any other society on at least an equal footing as to funds and finances, and excelling them all in number and quality of membership.

THE CHICAGO CONVENTION.

Our readers will have gathered from the various items that have appeared in our columns that the Chicago convention of the National Electric Light Association will be one of the very best that has ever been known by that useful body. The Association officials have prepared an excellent programme, as will have been noted, while there is every indication that the attendance will be unusually large, if only for the reason that a larger membership can be drawn upon from all parts of the country. Indeed, this increase of membership in the Association is one of the most striking features of its recent history, and we believe that the Chicago convention will do much to invite into fellowship many who have not yet joined. The influence and utility of such an organization depends to no small extent upon its representative character, by which we mean not merely numbers, but quality. In both respects, the Association certainly stands to-day at a higher point than ever, and from the earnest spirit characterizing the work for the Chicago meeting, we draw the brightest auguries for the future. Mr. Ferguson, himself a central station man of the finest type of experience and ability, and a worthy successor to the able presidents already furnished from the Chicago Edison Company, may well feel gratified at the condition of the Association.

THE VANCOUVER POWER PLANT.

It gives us great pleasure to present in another column a communication from Mr. K. G. Dunn regarding the very unusual hydraulic conditions encountered in this transmission system. We did not at all intend to be censorious in our recent comment, and are glad that it has brought out exactly the information which we desired. In brief, the engineers were confronted with the serious alternative between about seven miles of flume in a peculiarly treacherous soil and about two miles of costly tunnel. The latter was wisely chosen, we should think, since it gave better security against interruptions of service; and substituted a charge substantially fixed for a large and dangerous depreciation and maintenance charge. Incidentally, it gained a certain amount of useful storage capacity. Taken altogether, it is a particularly interesting study in hydraulics presenting a condition which is, so far as we remember, unique. Power transmission problems demand sometimes great finesse in the engineer, who must not hesitate to leave the beaten path whenever by so doing he can get around a difficulty. The treatment of such cases cannot be carried out on a well-defined system, but must be symptomatic, as our medical friends say. The detailed investigation of an instance like that before us is more instructive than the examination of half a dozen conventional plants carried out on canonical lines and requiring no special adaptations. As the development of water powers goes on, the number of difficult cases steadily increases, and powers hitherto unavailable are certain to be conquered and put into harness. Expedients like the Coquitlam tunnel and the great span across the Carquinez Straits are the results of necessity, enforced by the gradual occupation of the easier powers; and as time goes on we are likely to see more and more notable feats of engineering.

TYPES OF TRANSFORMERS.

We note in the Digest a controversy on transformer design between Messrs. Niethammer and Eborall which presents some points of interest. The latter contends that the shell type does not permit of both good efficiency and good regulation under inductive load; to which the former replies that as a matter of fact several large companies actually produce transformers up to the very largest sizes having regulation better than 3 per cent. and efficiencies of 98 per cent. or so built on the shell plan. To which Eborall retorts that these companies, particularly the two great American ones, cling to this out-of-date type because it is cheap, and especially because in American practice rotaries are systematically used, so that there is no need of transformers which regulate well on inductive loads of power factor 0.5 or less.

It is far from our purpose to defend the shell type of transformer, but this last argument calls for comment. We are inclined to the opinion that some American engineers are perhaps overfond of rotaries, but if the choice were between the universal use of these and a power factor of 0.5 without them, we do not see how any engineer in his right mind could think for a moment of the latter alternative. Many of our American power transmission plants are operated without rotaries, but we have yet to hear of one with so bad a power factor. We are tempted to inquire what sort of induction motors the Continental makers are turning out, if that be the kind of power factor resulting from their use. To our knowledge some of the Continental makers do build induction motors of singularly high power factors, and we are, therefore, forced to the conclusion that other makers must turn out extremely bad ones. Certainly in American practice, a plant with a power factor of 0.5 would be considered uniquely bad and a monument of incompetent engineering. When American manufacturers have to build transformers to meet such a specification, American engineering will have become a byword and a reproach.

THE HEATING OF OIL SUBMERGED WIRES.

The experiments of Prof. Perkins referred to on page 831 of this issue, illustrate the variations which may occur in the temperatures of submerged wires carrying electric currents. It is well known that a wire immersed in a liquid possesses relatively large thermal dissipation: i. e., will carry a relatively powerful current without overheating. The heat thus dissipated is almost entirely carried away from the wire by convection, the process of pure thermal conduction in liquids being very slow. That is to say, the thermal conductivity of liquids is relatively very small in comparison with the thermal conductivity of metals. The heating of the layer of liquid immediately in contact with the wire, by the ordinary process of conduction, has the effect of expanding that layer, and thus of setting up convection currents in the liquid, whereby the newly forming layers of liquid around the wire are enabled to absorb heat continuously. When, however, the process of convection is artificially accelerated by stirring, the rate of escape of heat from the wire may be greatly increased. In the experiments referred to, the thermal dissipation during stirring appears to have been seventeen times greater than during the period of non-stirring, when the oil was lef to its own natural convection. The ratio of increase in thermal dissipation accompanying stirring would naturally depend upon the geometrical distribution of the parts, the rate of stirring, and the thermal properties of the liquid. In general, it would offer a complex hydrodynamical problem for solution.

It might be possible to construct on this principle a fairly simple form of stream indicator, such as might be used to measure the rate of flow in rivers at different depths below the surface. A short horizontal wire might be held insulated between the prongs of a fork, so as to permit of being submerged to different depths. A portable storage battery and rheostat would enable the strength of current through the wire to be controlled. With the aid of a portable voltmeter and ammeter, it should be readily possible to observe the current strength required to raise the resistance of the wire, by a certain percentage, which would depend in its turn upon the temperature elevation of the wire. The electric power absorbed

by the wire, for a given temperature elevation, would increase when the rate of flow of the water past the wire increased, and could be interpreted to indicate, in feet or meters per second, by reference to a table. The apparatus should be dead-beat, swift and capable of a wide range. With such an apparatus the streams in different parts of river bed might be capable of rapid measurement. A similar piece of apparatus might also be made to serve as a dynamometer or wind measurer in the atmosphere. It is well known that the thermal dissipativity of a wire carrying a current in air is largely dependent upon the breeze blowing past the wire. Owing, however, to the essentially unstable and variable condition of the ordinary breeze, both in velocity and direction, the readings of the air-current measurer would probably be less steady and permanent than those of the water current measurer.

A PRELIMINARY STUDY FOR A NEW STANDARD OF LIGHT.

An article of the above title, by Mr. J. E. Petavel, has recently been printed in the London *Electrician*, and a preceding paper by the same author on a similar topic was communicated to the Royal Society in 1899. In that paper the author quoted experiments to show that the voltaic arc-crater was not a suitable standard source of light, the intrinsic brilliancy of the crater varying in different measurements from 136 to 160 candles per square millimetre. The temperature of the crater under corresponding limits was supposed to vary between 3935 and 4018° C., taking an empirical formula, in which the temperature varies as the 6.9th root of the intrinsic brilliancy. Put in another way, the intrinsic brilliancy of the crater is taken as increasing nearly as the seventh power of the temperature. This is even a more sensitive relation than that of the intrinsic brilliancy of an incandescent lamp filament, which is taken as increasing as the sixth power of the terminal voltage. The conclusion arrived at in the paper is that the arc crater is worthless as a standard source of light. This is not to be wondered at, because, assuming that the temperature of the crater were rigidly constant, and that the intrinsic brilliancy of its surface were likewise constant, the observer can only perceive that brilliancy through the arc flame: i. e., through the vapor and mist of the arc. The luminescence and absorption of these gaseous bodies are no doubt liable to rapid variation, and they may seriously affect the photometer.

On the other hand, the paper described a number of observations tending to show that the Violle molten platinum standard of light was much more reliable. A small bar of platinum is suitably screened so as to admit to the photometer only the light from a measured surface of the heated platinum. The platinum is heated either electrically in one form of apparatus, or by the oxyhydrogen blow pipe in another. After the platinum has been melted, it is allowed to cool off slowly. The intrinsic brilliancy of the glowing surface falls rapidly until the freezing temperature of about 1770° C. is reached. Here the intrinsic brilliancy remains uniform, apparently, until the entire active surface has frozen, and the process of congelation with uniform brightness may last nearly a minute. The conclusion was reached that such a standard light source had a probable variation not exceeding one per cent.

In the more recent paper the author discusses the various means of measuring the temperature of a hot body, such as a bar of molten platinum. He concludes that the only reliable method involves the measurement of the relative intensity of the radiation of two different emitted wave lengths. An experimental study of the properties of screens at various temperatures between 1000° and 1700° C. shows that while glass becomes more transparent to the total radiation as the temperature rises, black fluorspar becomes more opaque. Consequently a pair of thermo-electric coils connected in opposition series with a galvanometer, one illuminated by the arc through glass and the other through black fluorspar, produce zero current and galvanometer deflection at one particular temperature. Under definite conditions, the author regards this temperature as definitely reproducible.

THE METRIC SYSTEM IN GREAT BRITAN.

The last number of the *Journal* of the British Institution of Electrical Engineers contains a very interesting discussion on the subject of the metric system of weights and measures, held on the 22d of January last. A short paper was read by Mr. Alexander Siemens on the subject, favoring the general and universal adoption of the metric system. The gist of the paper was that international communications, as well as national convenience, rendered a universal systematic system of weights and measures eminently desirable; that the metric system has been successfully adopted by all or nearly all of the civilized nations of the world, except the English-speaking nations; and that no nation that has adopted the metric system has reverted to its primitive savage customs of metrology. Against this presentation, the war-horses of the British inch trotted forth to battle. It was pointed out as an unanswerable argument against the metric system that Napoleon Bonaparte objected to the metric system, and did not think it would work. No one disputes that the Little Corporal was a great soldier, and a man of strong views. But what bearing his preference for the ridiculous then existing French medley of weights and measures over the then new-fangled metric system has on the existing case, it is difficult to see. The old French medley is dead and unressurrectible. So is Bonaparte. In view of events in French history during the last century, it would probably be hard to find a hundred Frenchmen who would now seriously agree with Bonaparte's views on this subject, as quoted.

The conservatives in debate clung not only to British measures, but also to the British pound, shillings and pence, and in the main, for the same reasons. This to Americans will be a flaw in the armor, for practically every American admits that the decimal United States currency is far more simple, logical, rational and scientific than the guinea, pound, crown, florin, shilling, penny, farthing, mite system. It is quite true that an American who writes down his wealth as ten thousand dollars, can by an accidental shift of the decimal point, make himself appear a millionaire. Nevertheless, such errors are very uncommon in good faith. Since then the devotees of the league, mile, furlong, pole-or-perch, rod, link, fathom, yard, foot, inch, mil, barley corn system advocate the retention of the British coinage for substantially the same reasons as for the grand old linear jumble. And since we all know, on this side of the Atlantic, that the decimal coinage is incomparably better, is it not reasonable to suspect that the arguments for the retention of the linear jumble, which we, too, retain as a national fetish, may be similarly unsound?

One gentleman is reported deprecating the use of decimals in currency as compared with the pound, shilling, pence system, because the decimal system "gets rid of a perpetual opportunity of doing a little mental arithmetic." This seems to have been spoken in earnest, and not as a joke. The dollar, cent system is too easy, it would seem. What a blissful example of the principle of "how not to do it" and how beautiful a realization of the majesty of needless labor. Let us make things hard, and keep them hard, that we may have to take extra time to do them, and make education burdensome to every succeeding generation. Wonderful, indeed, is the influence of conservatism! There is no fallacy or superstition so gross that conservatism will not enshrine it. Taken as a whole, the discussion seems to show that there is a large and growing section of electrical engineers in Great Britain who favor the advent of the international metric system.

Progress of Work for Union Engineering Building.

On the evening of May 7, in accordance with invitation, the boards of direction of the several bodies interested, as well as some other members of the different societies, held an informal meeting at the house of the American Society of Civil Engineers, to consider the gift of $1,000,000 from Mr. Carnegie for a Union Engineering Building. Sixty-five gentlemen were present, including President A. Noble, of the Civil Engineers, Dr. A. R. Ledoux,, of the Mining Engineers; J. M. Dodge, of the Mechanical Engineers; C. F. Scott, of the Electrical Engineers, and J. C. Kafer, of the Engineers' Club. The meeting organized with the election of Mr. Noble as chairman and the appointment of Mr. T. C. Martin as secretary.

A very free, frank and open discussion of the subject, its advantages and its possible objections, was had, lasting about three hours.

The president of the American Society of Mechanical Engineers, Mr. James Mapes Dodge, reported that at a meeting of their council in the afternoon, the formal resolution proposed in the letter of W. A. Redding, Esq., May 1st, had been adopted, and a committee appointed comprising Prof. F. R. Hutton, C. Wallace Hunt and himself. This committee is to act first as a conference committee, and is authorized to make such changes in harmony with the spirit of the resolution adopted as may be deemed advisable upon conference with committees of the other bodies. The same committee is to be retained as a permanent committee.

The president of the American Institute of Electrical Engineers stated that the board of directors had endorsed the resolution proposed by Mr. Redding, and had appointed a conference committee, comprising Mr. Calvin W. Rice, Mr. T. C. Martin and himself, with instructions to report back a definite form of resolution which should be adopted. He further stated that it was expected by the board that final action would be taken on May 19, as there was a board meeting and also an annual meeting of the Institute on that day.

The president and the secretary, Dr. Raymond, of the American Institute of Mining Engineers stated that their institute would have a board meeting on the following day. Both of the gentlemen, however, were in hearty accord with the plan, and said that they considered it not a question of whether they should come in, but of the best ways and means of doing so.

The American Society of Civil Engineers will probably have a board meeting within the present week. One of the past ex-presidents, Mr. George S. Morison, stated that as they already had a building the conditions were different with their society; but after giving the matter careful consideration, he was of the opinion, speaking for himself, that the relations which they should sustain to the general engineering interests were such that leaving aside their own individual preferences, the society should join with the others.

Representatives of the Engineers' Club expressed hearty accord with the general scheme. Mr. Kafer stated that delegates to the conference would be appointed at the meeting of the officers on May 11. He also stated during the evening that Mr. Carnegie had generously undertaken to finance the land for the societies, and that interest at the rate of 4 per cent. on the land investment would not be asked by Mr. Carnegie until the building itself was finished. Mr. Carnegie's financial agent, Mr. R. A. Franks, had already paid out for them $50,000 in options on the property on West Thirty-ninth Street, which now represented a buying price of $517,000.

Resolutions were adopted without a dissenting vote, expressing appreciation and thanks to Mr. Carnegie for the generous offer which he has made, and a cablegram of gratitude to him for his offer drafted by Mr. Morison was adopted and sent. The resolutions read as follows:

At an informal meeting held on the evening of May 6, 1903, at the house of the American Society of Civil Engineers, attended by members of the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the Engineers' Club of New York City, it was resolved,

I. That those present hereby signify their profound appreciation of the recent action of Mr. Andrew Carnegie in donating to the cause of engineering, and in recognition of the engineering profession, the sum of $1,000,000 for the erection of a Union Engineering Building; and also for otherwise making it possible to accept and utilize this sum by his liberal, unencumbered and prompt co-operation in financing a suitable site.

II. That it is their firm belief that the result of this initiative will be potent for good, and of far-reaching inclusiveness, greatly increasing the effectiveness of the engineering profession, both technically and socially, and with corresponding benefits to the industrial arts and the world at large.

III. That they hereby tender to Mr. Andrew Carnegie their gratitude for his generous offer.

It was agreed that the Conference Committee, consisting of three representatives from each of the five bodies, should be called to determine upon the next steps and the next action by the several bodies.

Since the above was prepared, the officers of the American Institute of Mining Engineers have met and have appointed Dr. A. R. Ledoux, Charles Kirchhoff and Theodore Dwight as their conference delegates. At a meeting of the board of the Engineers' Club on May 11, Messrs. J. C. Kafer, W. H. Fletcher and W. A. Redding were appointed conference delegates.

Mr. C. F. Scott has called the conference for Friday evening, May 15, at the Engineers' Club. In the meantime, every member of the American Institute of Electrical Engineers has been fully advised on the subject, and an active campaign is in preparation to give the Institute its proper place in the work of carrying the scheme to its fulfilment. In addition to the literature already circulated, a large amount of interesting and pertinent data will also be given in the current *Bulletin* of the Institute.

N. E. L. A. Special Train for Chicago.

Mr. C. O. Baker, Jr., master of transportation for the National Electric Light Association, has issued the following special circular of information: "Arrangements have been made with Mr. M. C. Roach, general Eastern passenger agent New York Central Railroad, for a special train of Pullman cars for use of Eastern members and delegates attending the twenty-sixth convention of the National Electric Light Association, to be held at Chicago, May 26, 27 and 28.

"This train is scheduled to run by New York Central & Hudson River Railroad and Michigan Central Railroad, leaving New York Sunday, May 24, at 12.50 P. M.; Albany at 3.50 P. M.; Buffalo (Central time), 10.50 P. M.; Boston via Boston & Albany, at 10.45 A. M., arriving Chicago 2.50 P. M., Monday. Fare from New York, $22; return, $6.70; double berth in sleeping car, $5; drawing-room, $18.

"Replies from former circular regarding transportation indicate an unusually large attendance, and as space on this train is limited, it is suggested that those desiring accommodations apply quickly to M. C. Roach, General Eastern Passenger Agent, 1216 Broadway, New York, and members from Boston and vicinity should apply to J. L. White, City Passenger Agent, 366 Washington Street, Boston."

In view of the numerous inquiries reaching us we would advise our Eastern readers going to the convention to secure their accommodations as quickly as possible.

Mr. James Wolff has been appointed by President Ferguson as chairman of the local reception and entertainment committee for the convention of the National Electric Light Association.

This committee has arranged to have a general reception in the Auditorium parlors on Monday evening, May 25, from 8.30 to 10.30. Arrangements are also being made for a tally-ho party on Tuesday morning for the ladies attending the convention, to drive to the Washington Club, where they will have luncheon. After luncheon they will drive through the South Parks, returning to the hotel in the afternoon. A matinée party at one of the theatres is contemplated for the ladies on Wednesday afternoon.

International Electrical Congress.

It is probable that the International Electrical Congress will be held at St. Louis during the week of September 12-17, 1904. This will accommodate the college men and the foreigners as to time, and will allow those who care to stay over and attend the International Congress of Arts and Sciences, which occurs the following week. It now seems probable that most of the national electrical associations will also assemble in St. Louis during this week. The Exposition Company will accommodate all of the latter with free convention halls, and, on certain special electrical days during this week, free admission to the grounds will be granted. Advices from abroad point to a large attendance during congress week. A party of 40 Italian engineers has already arranged to be present at that time.

Branly-Popp Aerial Telegraphy System.

BY HENRY HALE.

ONE of the most interesting systems of wireless telegraphy in Europe is that known as the Branly-Popp system. Dr. Branly, to whom the art of wireless telegraphy owes its being through his discovery of the principle of the coherer, some time ago devised a new form of coherer, based upon the simple contact of a polished and an oxydized metal surface. Since then this form of coherer has been improved and brought to a practical shape, and forms the base of the new system of wireless telegraphy.

To obtain the contacts of oxydized and polished metal he has arranged the coherer in the shape shown in Fig. 1. An upper disc of metal has fixed into it three rods of tempered steel, tapering and pointed at the ends. The points of the rods are somewhat rounded off and given a high polish, after which they are given a very thin layer of oxide by heating in air to a suitable temperature. The use of three rods is adopted to give the coherer a convenient and practical shape and serves to afford three separate contacts to secure good working. The tripod thus formed is placed upon a disc of steel, which has been given a high polish.

The coherer effect under the action of the waves thus takes place between the points and the highly-polished surface, and upon striking or tapping the coherer, it comes back to the state of non-conductivity. It was found that the shock required to bring back the coherer was much slighter than in the ordinary case and this gave Dr. Branly the idea of mounting the coherer directly upon the Morse receiver, when the striking arm of the armature is all that is needed to restore the coherer after the signal has been registered. The new receiver thus forms a compact and extremely simple instrument, as will be observed in Fig. 2, which shows the coherer enclosed in a cylindrical glass case and mounted upon a small platform, which is supported on a column. The inner end of the platform serves to hold the lower tapping-screw of the instrument. Each time the arm taps the lower screw a shock is given to the coherer, which is sufficient to bring it back to a non-conducting state. The upper tapping-screw is insulated from the body of the instrument and is connected to one pole of a battery (a cell of 1 volt or ½ volt is sufficient); below, it touches a platinum disc which is mounted on the armature lever. From the disc (which is insulated) the current passes by a flexible wire through the coherer and a sensitive relay back to the battery.

When a wave reaches the receiving station the coherer becomes conductive; the battery operates the relay and the latter the Morse register, as usual, through a secondary circuit. The armature lever is attracted to register the signal, and at the same time the current is broken between the screw and the disc. When the lever strikes the screw the shock restores the coherer. Finally, the lever rises, again making the contact between the screw and disc, the circuit being now broken at the coherer and ready to receive a second signal.

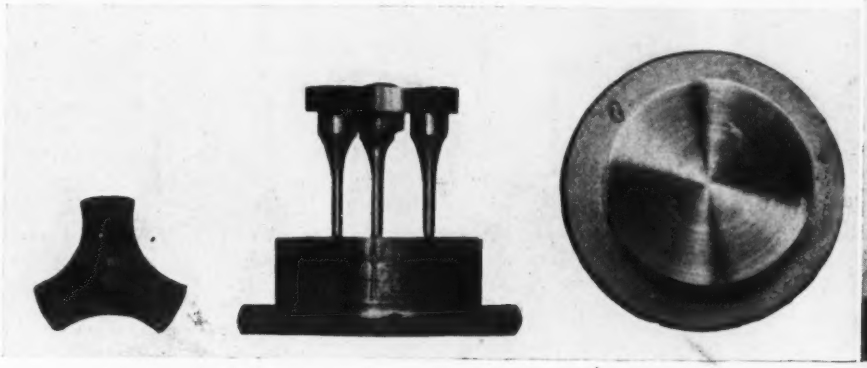


FIG. 1.—COHERER.

The independent striking device ordinarily employed with a coherer requires a certain time to act, which thus diminishes the speed of receiving the messages. In the present case the striker is dispensed with and consequently a gain in speed has been secured. Experiments show that the receiver can take down as many as 35 words per minute, which is much faster than ordinary. Besides, the new coherer has proved to be much more sensitive than the usual type with metal filings, and some experiments made by Dr. Branly to compare different coherers show that it is from 5 to 7 times as sensitive. This renders the new system particularly adaptable in the matter of transatlantic messages, and experiments are soon to be made in this line.

A company has been formed in Paris to operate the new system, headed by M. Victor Popp, an engineer of note, and promoter of various enterprises. At present there are two different schemes under way. The first is to provide for a system of communication throughout the City of Paris between a central station and subscribers, which will be somewhat novel; the second is to build a number of maritime stations at different points on the coast of France. Both these projects are of great interest, and will no doubt lead to important developments in the future. For the Paris system it was first necessary to erect several stations in order to prove that the signals could be sent without difficulty over the city. At present there are four different posts already established in different parts of the central district, one being at the company's main offices, the second near the Bourse and the other two at newspaper offices.

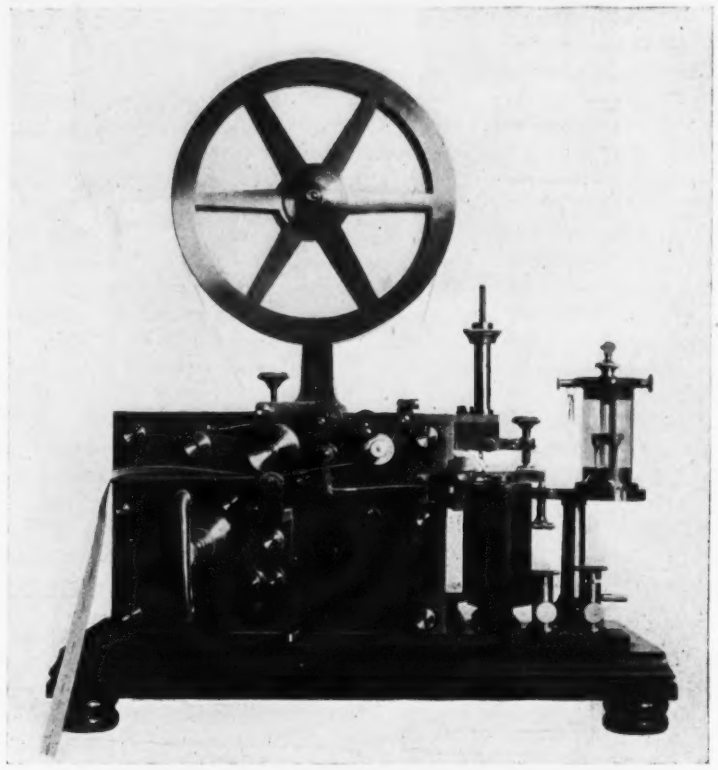


FIG. 2.—BRANLY RECEIVER WITH COHERER.

FIG. 3.—MAST ON MAIN STATION NEAR THE MADELEINE.

These stations have masts over 100 ft. high, mounted on the roofs. Since they have been installed there has been no difficulty in sending and receiving the signals between the stations, as was pre-

dicted by some, and they are now in constant communication throughout the day. Seeing that there is no practical difficulty, the

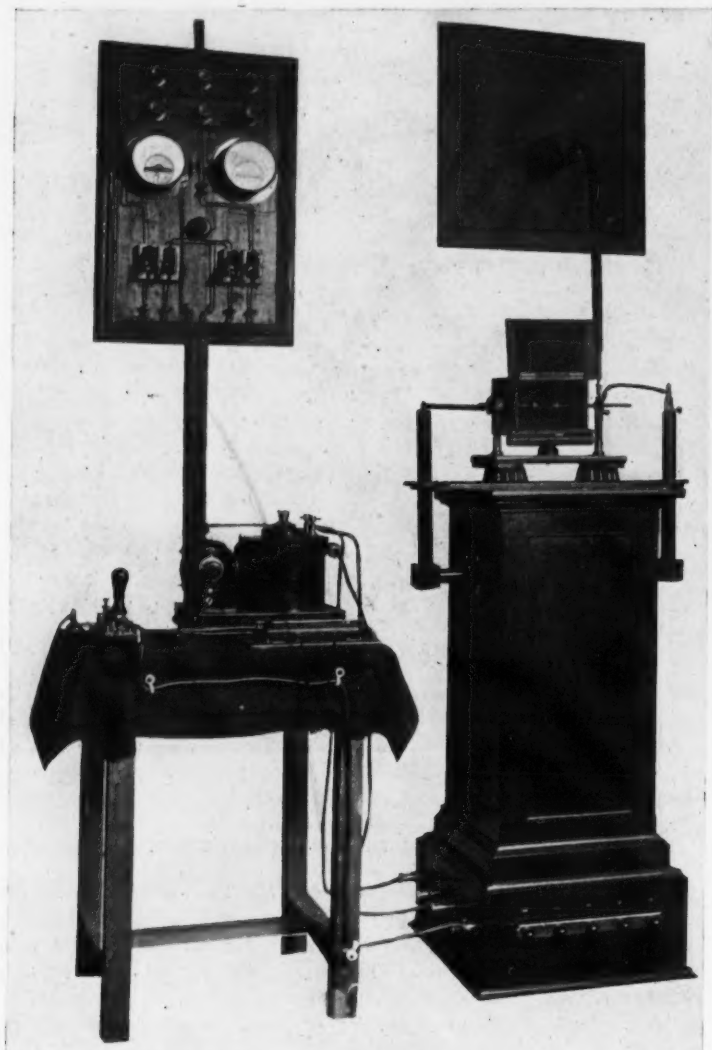


FIG. 4.—TRANSMITTER FOR 30 MILES DISTANCE.

next step will be to fix a central station in the central part of the city, analogous to that of a telephone system. Over the town will be located some 30 or 40 receiving stations, each forming the center of a district. The central station will receive telegraphic and tele-

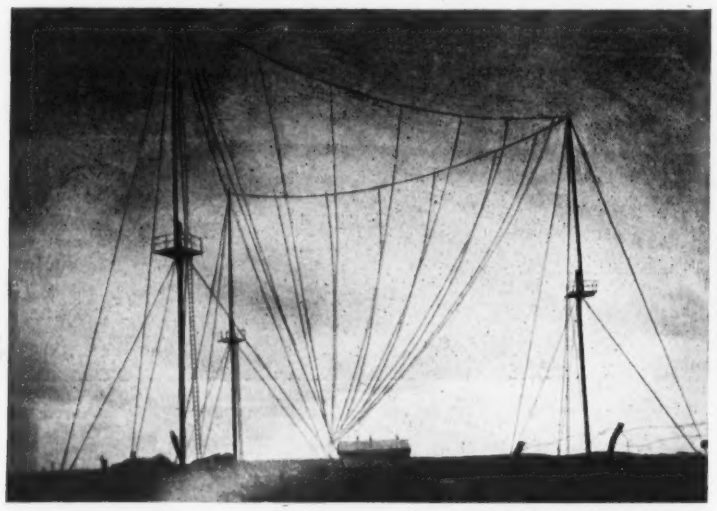


FIG. 5.—MAST SYSTEM AT CAP DE LA HAGUE.

phone news of all the leading events of the day, as they occur. For business purposes, the stock quotations, markets and operations of the Bourse will be the most important, then political and social news, such as makes up an ordinary newspaper, but the subscribers will have the advantage of receiving this at all hours of the day. Each of the subscribers will not, of course, be provided with a receiving station, but it is proposed to carry the news from the branch offices to the residences by means of messenger boys mounted on bicycles.

The mast, which is mounted on the roof of the company's offices at Place de la Madeleine, shown in Fig. 3, is 115 ft. high, and communicates with similar masts placed on the three other buildings. The transmitting outfit is shown in Fig. 4. The table on the left

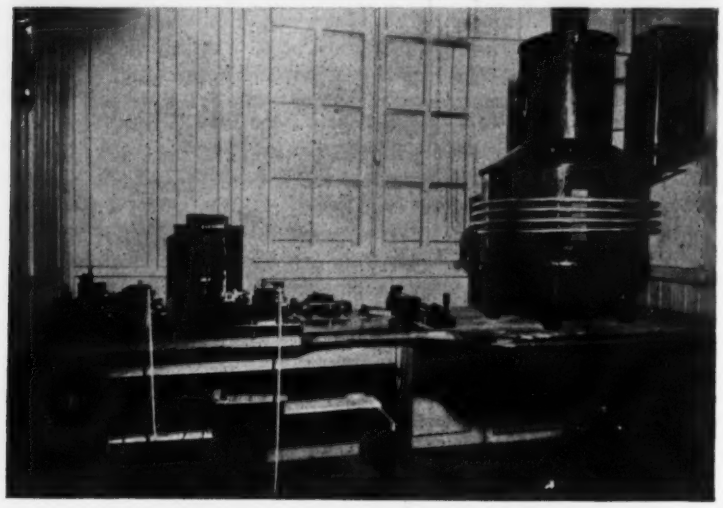


FIG. 6.—SYNTONIZING APPARATUS, CAP DE LA HAGUE.

contains the usual transmitting key and the mechanical interrupter for the induction coil, operated by a small motor. The large box on the right contains the induction coil, having its condenser mounted in the base, while on the top are the spark-balls and the cable which goes out to the mast. The receiving outfit includes the register and coherer shown in Fig. 1, with its battery and a Claude relay. The coherer enclosed in a glass case is protected from the air and a flexible wire attached to the tripod allows it to be lifted off the base when out of action.

The system thus proposed is certainly a novel one and it is expected to carry it out in the near future. To send in the news from the outlying districts and especially the news of the races, which are followed with great interest, a special form of automobile van has been built. It is equipped with a high bamboo mast, which is mounted in a socket on the roof and braced by wires. The mast can be quickly set up or dismounted. The interior of the van forms a traveling station, and has transmitting instruments of the above-mentioned type. The gasoline engine of the automobile is used to drive a small dynamo, which serves to keep charged a set of accumulators for the current supply. At the time of the races, or on

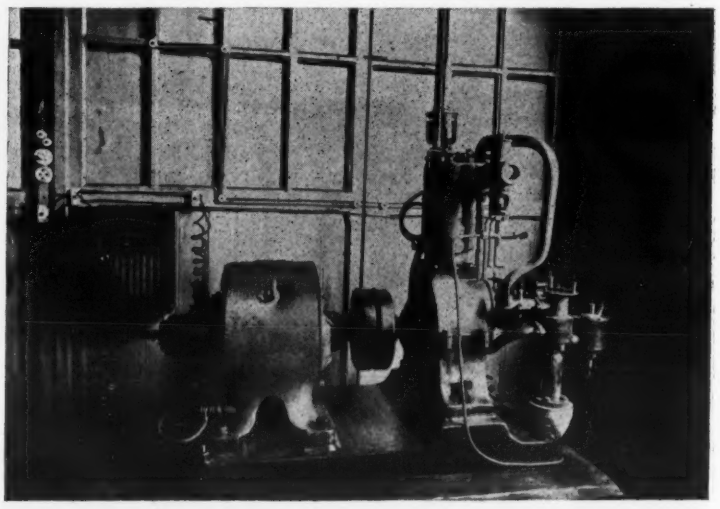


FIG. 7.—CAP DE LA HAGUE MARITIME STATION.

hearing of any special event, accidents, etc., within a radius of 10 or 20 miles, the automobile is always ready to go to the spot and send in the news.

The maritime project has been commenced by the construction of a large station at Cap de la Hague on the north coast of France,

near Cherbourg, which is illustrated in Figs. 5 and 9. The post is equipped with three masts 130 ft. high (Fig. 5) which form a triangle of 130 ft. on a side. At the center of the triangle is the station building, which has four rooms, one of which contains the apparatus for transmitting and receiving. The station (Fig. 6) will

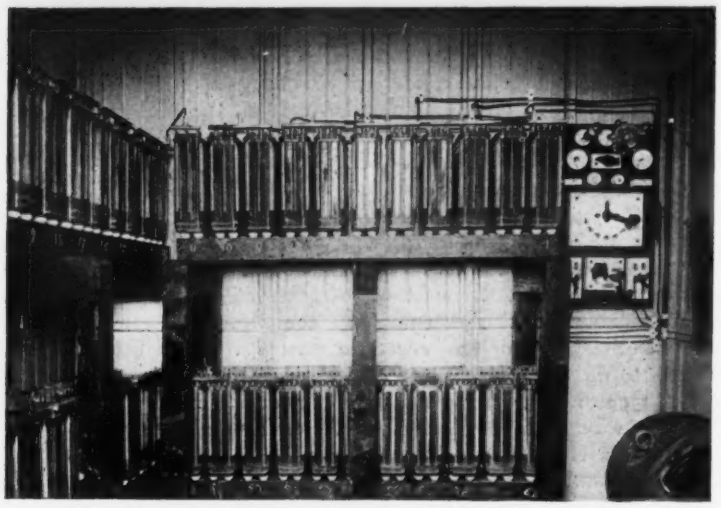


FIG. 8.—ACCUMULATORS.

use the above-described apparatus with the addition of a new syntonizing system devised by Dr. Branly, a description of which has not yet been made public. This station will receive telegrams from the ships provided with Marconi and Slaby-Arco systems and will also connect with the different Marconi stations in England and Ireland. A second post of the same character is being built at Cape Gris Nez on the Channel near Boulogne, and these two posts will cover the Channel from the Holland frontier on the east, and extend westward to the ocean at a distance of 900 miles from Cherbourg. The

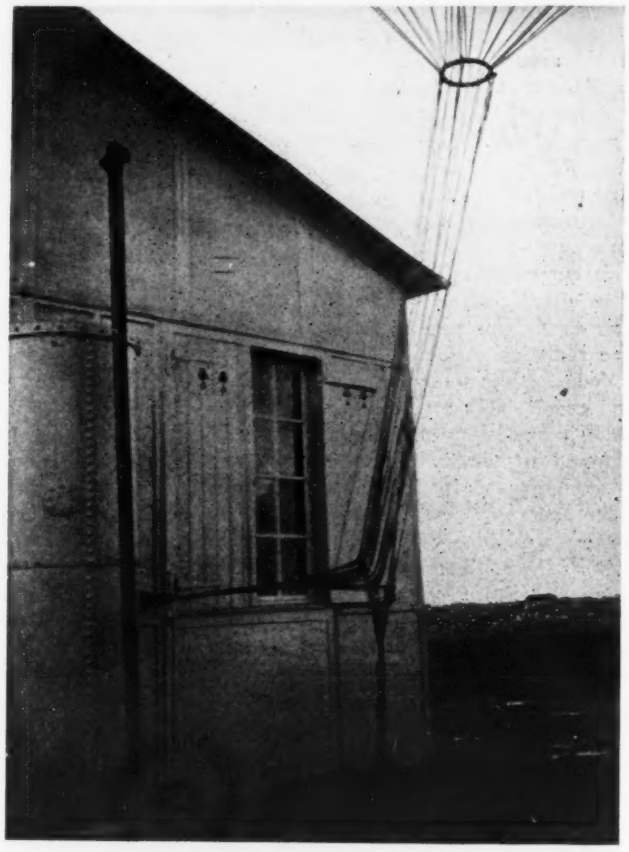


FIG. 9.—MAST WIRES ENTERING STATION.

syntonizing apparatus, which can be regulated for different lengths of waves, will thus permit of receiving all the signals transmitted by posts within a distance of 900 miles. The second room contains a generating set to supply the current (Fig. 7), consisting of a 5-hp gasoline motor, driving a small dynamo to charge storage batteries contained in the third room (Fig. 8).

The tops of the masts are connected by a steel cable, which serves to support the 15 mast wires, which are attached at regular intervals. All the mast wires are brought to the center at the station (Fig. 9). The post at Cap de la Hague is situated only 300 ft. from the government telegraph post, which is also provided with a mast. In this way the messages which are received can be transmitted at once to Paris or throughout the country. After the station is in working order an attempt will be made to send messages across the Atlantic, and Dr. Branly thinks that this can be easily done with the new receiver. The two stations will no doubt be followed by others along the coast of France.

Boise, Idaho, Transmission Plant.

The water power plant of the Boise-Payette River Electric Power Company, shown in the accompanying illustration, is located on the Payette River, Idaho, near the Horseshoe Bend, a distance of about 27 miles northwest of Boise, Idaho. This plant, including transmission lines to Boise and Pearl, and a distributing sub-station, was installed at an approximate cost of $350,000.

The water is taken from the Payette River at Horseshoe Bend, a distance of three miles above the power house, and carried through a large canal. The head or fall of water gained in this distance is 20 ft. at the power house. The water power is derived from two 1,200-hp water wheels direct-connected by means of flanged couplings to two 1,000-hp rotating field polyphase generators. The exciters are of the engine type class, direct-connected to the gen-

FIG. 1.—GENERAL VIEW OF STATION AND CANAL.

erator shaft. The electric power is generated at a potential of 500 volts, and raised to 23,000 volts through self-cooling oil transformers. It is transmitted at this voltage over three lines of No. 2 stranded aluminum cable, a distance of 23 miles to Boise, where the voltage is reduced by step-down transformers and distributed through the local circuits in Boise at 2,300 volts for light and power for commercial purposes, and to a converter sub-station for the operation of the street railway system.

From the power house on Payette River the pole line for a distance of 12 miles is of double construction, two independent circuits being carried on the same pole. One of these circuits branches to the mining camp of Pearl, where the power is used for the operation of the mines in driving compressors, electric hoists, and for general power purposes. At Pearl is located the famous Checkmate and California mines. The latter has recently encountered a large body of ore carrying very high values. These mines are making preparations for operating their properties entirely by electric power.

The power house is designed for three generator units of 1,000 hp each and provision is made for future extensions when necessary. The canal (Fig. 1) has a carrying capacity sufficient to generate 5,000 hp. After the water passes through the turbines it is again delivered to the river without loss and taken out below for irrigation purposes.

Fig. 2 gives an exterior view of the power house, and Fig. 3 an interior view, showing the generator switchboard and lightning apparatus.

The net weight of the generators complete is 65,000 lbs; the rotating

field weighs 17,500 pounds and it required 20 horses to haul this piece of apparatus from the railway station at Emmett over the mountain to the power house, a distance of 14 miles. The diameter of the rotating field is 12 ft. The generators are set on deep concrete

FIG. 2.—EXTERIOR VIEW OF POWER HOUSE.

foundations and direct-connected to the water wheels in the manner mentioned above.

The development of the distant water powers and transmitting power to mining camps, which are located a distance from fuel supply, and in some cases water supply, has made it profitable to

FIG. 3.—INTERIOR VIEW OF POWER HOUSE.

develop mining properties with the use of electric power, that would not have been profitable were they compelled to haul fuel any great distance.

The entire electrical installation was furnished by the Westinghouse Electric & Manufacturing Company, and the water wells were supplied by the James Leffel & Company, of Springfield, Ohio.

Auto Bus in London.

A cable dispatch from London of May 9 to a New York daily newspaper says: "The trial of the American automobile bus built for the London General Omnibus Company by the Fischer company this week was very satisfactory. The run was to Richmond and back. The journey, owing to the route chosen, must have covered twenty-five miles at least, and nothing was more remarkable than the ease and facility with which the huge vehicle was made to thread its way through the crowded traffic of Piccadilly Circus, Regent Street and Oxford Street. The new bus excited the liveliest interest on the road, and though things, both humorous and unprintable, were hurled at it by some of the more conservative whips, especially when their horses jibbed, the vehicle, it is fair to assume, has come to stay." The Fischer system combines the use of gasoline and electricity on the same vehicle, current being generated by the gasoline plant.

Field Coil Formulas.

BY THORBURN REID.

THE calculation of the weight of copper, depth of coil, number of turns, size wire, etc., in a field coil is usually tedious work. In order to lighten this work as far as possible I deduced some years ago the following approximate equations and, having used them constantly in my work ever since, have found them to be as accurate as the practical conditions warrant.

They are based on the assumption that all the heat generated in the coil will be radiated from its outside surface only, the end surface and the inside surface being neglected. This assumption is sufficiently accurate for most field coils, although, if the depth of the coil is great as compared with its length (across wires), the heat emitted by the end surfaces may in some cases have to be taken into account also. However, even in such cases the end surfaces are often enclosed by non-conductors of heat or are contiguous to other hot bodies, so that rather than to complicate the calculations by introducing more or less uncertain factors, it seems better in most cases to fix a constant of watts per square inch by experiment for each type of machine using the outside surface only.

The wire table issued by the American Institute of Electrical Engineers is used as a basis for weight and resistance of copper wire. In this table copper is assumed to weigh .3214 pounds per cubic inch and its resistance at 60° C. is $.773 \div 10^6$ ohms per cubic inch. The formulæ are all based on a temperature of 60° C., since the coil will usually nearly attain this temperature in practice, and should not exceed it much.

All dimensions are given in inches unless otherwise stated, and the following notation is used:

D = diameter of inside of coil. The clearance and insulation between the coil and the field pole are added to the pole diameter to obtain D.

f and k are the two dimensions of the inside of the coils wound on rectangular field poles and clearance and insulation must be allowed for as with D.

t = depth of coil; that is, the actual depth of insulated wire, and does not include any insulation that may be wrapped around the coil.

l = length of coil across wires.

n = ratio of the bare to the insulated diameter of wires.

P = weight of copper in the coil in pounds.

$W = I^2R$ loss in the coil.

R = resistance of the coil in ohms.

w = watts per square inch of radiating surface.

N = number of turns in the coil.

I = current in coil.

d^2 = circular mils of wire used.

E = e.m.f. impressed on terminals of coil.

S = radiating surface.

In deducing the following equations, the wire is considered to be wound evenly in layers and in the case of rectangular poles no allowance is made for the rounding of the coil at the corners. It has been found in practice that the errors due to these assumptions are about compensated for by unavoidable irregularities in winding, so that the exact equations below give very accurate results when the winding is well done.

Most of the arithmetical work, both in deducing constants and in working out examples, was done with a 14-in. slide rule, since greater accuracy than this would give was not necessary.

The resistance of the coil being proportional to the total length of wire divided by its area, we have

$$R = \frac{.773}{10^6} \frac{N\pi(D+t)}{\pi/4\, d^2/10^6} = 3.092 \frac{N(D+t)}{d^2} \qquad (1)$$

$$d^2 = \frac{tln^2}{N} 10^6 \qquad (2)$$

$$W = I^2R = 3.1 \frac{N^2(D+t)}{tln^2} I^2 \qquad (3)$$

But W also equals the watts per square inch of radiating surface multiplied by the radiating surface, or $W = \pi wl(D + 2t) = 2wl(f + k + 4t)$ (4) and from (3) and (4)

$$t = .984 \frac{\left(\frac{NI}{10^3}\right)^2}{wl^2n^2} \frac{D+t}{D+2t} = .984 \frac{\left(\frac{NI}{10^3}\right)^2}{wl^2n^2} \frac{f+k+2t}{f+k+4t} \qquad (5).$$

Since the ratio of t to D or to $f + k$ will generally not exceed 3, the last terms of (5) will range from 1 to .8125, and reducing the constant .984 to .9 and making the last terms of these equations equal to one, the maximum error will not exceed 10 per cent., and the maximum error in final results will not exceed 3⅓ per cent., since only the radiating surface and the mean length of a turn are affected and these are functions of the pole dimensions plus the depth of the coil.

Equations (5) then reduce to one equation, which is

$$t = .9 \frac{\left(\frac{NI}{10^3}\right)^2}{wl^2n^2} \qquad (6)$$

for both cylindrical and rectangular coils.

Since ampere turns are usually in the thousands, dividing them by 10^3 facilitates calculations.

Since $W = IE$, we have $N = \frac{E\ (NI)}{W}$ (7)

Also from (1), since $E = IR$, we have

$$d^2 = \frac{3.1\ NI\ (D + t)}{E} = \frac{2NI\ (f + k + 2t)}{E} \qquad (8)$$

$$P = .3214\ ltn^2\ \frac{\pi}{4}\ (D + t) = .3214\ ltn^2\ \frac{\pi}{4}\ 2(f + k + 2t) \qquad (9).$$

Substituting values of t from (5), these become

$$P = .78 \frac{\left(\frac{NI}{10^3}\right)^2}{wl} \frac{(D + t)^2}{(D + 2t)} = .497 \frac{\left(\frac{NI}{10^3}\right)^2}{wl} \frac{(f + k + 2t)^2}{f + k + 4t} \qquad (10)$$

Neglecting t in the final fraction, as before, and slightly changing the constants, we have

$$P = \frac{.8 \left(\frac{NI}{10^3}\right)^2 D}{wl} = \frac{.5 \left(\frac{NI}{10^3}\right)^2 (f + k)}{wl} \qquad (11)$$

The value of n^2 varies both with the size and with the make of the wire used. For machines above 4 or 5 kw I have found .85 to be usually sufficiently accurate for this factor, and in smaller machines .65 for 500-volt shunt-wound machines and .75 for 125 or 250-volt machines. The designer soon learns the best preliminary value for n^2 for any particular size of machine and make of wire, and as n^2 appears only in the equation for t, final results are only slightly affected by an error in its value.

The size wire given by formula (8) will generally lie between two sizes of wire given in the table, and it is sometimes desirable to wind the coil with two sizes of wire instead of using the size that comes nearest to the correct one. The following formula may be used to determine the proper number of turns of each size wire to be wound in the coil. This formula is based on the assumption that the mean length of a turn is the same for the two parts of the coil wound with the two sizes of wire. The error due to this assumption is practically negligible.

Let N = total number of turns in the coil, d^2 = the circular mils given by the formula, d^2_1 and d^2_2, the circular mils of the two nearest sizes of wire in the table, N_1 and N_2 being the corresponding number of turns of each size wire. Then $N_1 = \frac{d^2 - d^2_2}{d_1^2 - d_2^2} N$ (12) and

$$N_2 = N - N_1 \qquad (13).$$

Occasionally the series and shunt coils of a dynamo are wound one outside of the other and as the radiating surface is only the outside surface of the outside coil while the I^2R loss is developed in both, the question arises how much of the total depth of the coil must be assigned to each. First add together the ampere-turns required by the two coils and, by equation (6) find the total depth that is required for this number of ampere-turns. If but one coil of a single size wire were used the current density would be the same throughout the coil and this condition should be satisfied in proportioning the depth to the two coils, or d^2/I should be constant for the two coils. From (2)

$$\frac{d^2}{I} = \frac{t\,l\,n^2}{NI}\,10^6 \quad \text{or} \quad t = \frac{NI\,\frac{d^2}{I}}{10^6\,l\,n^2}$$

Since l and n are practically the same for the two coils, this equation shows that the depth should be divided in proportion to the ampere-turns in each coil, or $t_1 = \frac{t\ (N_1 I_1)}{(NI)}$ (14) and $t_2 = t - t_1$ (15). Then, since with constant current density the I^2R loss will vary directly with the depth, $W_1 = \frac{t_1}{t} W$ (16) and $W_2 = W - W_1$ (17), whence N and d^2 can be determined from (7) and (8) for the shunt coil. In the case of the series coil I is known and N is obtained directly by dividing the ampere-turns by I, the size wire being such as will make the current density the same as in the shunt coil.

Equations (4), (6), (7) and (8) furnish the number of turns and the size wire to be used in the coil, while equation (11) gives the weight of copper in the coil directly without the necessity of determining the number of turns or the size wire.

The following equations are also convenient at times: $R = \frac{E}{I}$

$$\frac{d^2}{I} = \frac{t\,l\,n^2}{\left(\frac{NI}{10^3}\right)} 10^3$$

The following examples were chosen at random from my files of data of actual machines, the dimensions having been taken from drawings and specifications and the results from reports of tests of the finished machines. They are not to be taken as examples of good design, as the value of w in all of them was lower than was advisable. They were chosen because I happened to have complete data both of dimensions and of results of tests.

EXAMPLE I.

Following are data taken from drawings and tests: $D = 8.75$; $l = 4.33$; $w = .383$; t = 3.1; $I = 2.97$; $N = 1{,}600$; $NI = 4{,}750$; $R = 8.815$; $E = 26.25$; $P = 96.5$; wire, No. 12 B. & S., diameter, .081, double-cotton-covered, to .091.

VALUES OBTAINED BY FORMULA.

$$d = \frac{.9 \times 4.75^2}{.383 \times 4.33^2 \times .85} = 3.34 \qquad (6)$$

$$W = 3.142 \times .383 \times 4.33 \times 15.43 = 80.5 \qquad (4)$$

$$N = \frac{26.25 \times 4{,}750}{80.5} = 1{,}550 \qquad (7).$$

$d^2 = 3.1 \times 4{,}750 \times 12.1/26.25 = 6{,}800$ (8). No. 12 B. S.

$$P = \frac{.8 \times 22.6 \times 8.75}{.383 \times 4.33} = 95.5 \qquad (11).$$

ERRORS.

In t, + 7¼%; in N, — 3¼%; in d^2, + 4%; in P, — 1%.

EXAMPLE II.

Data: $f = 4.52$; $k = 20.27$; $t = 1.08$; $N = 160$; $NI = 3{,}220$; $I = 20.1$; $R = .201$ at 44° C.; $E = 4.05$; $P = 90$; $I^2R = 81.3$; $S = 415$; $w = .$VTF. No. 4 B. & S., .204 d-c-c to .216.

VALUES OBTAINED BY FORMULA.

$$t = \frac{.9 \times 3.22^2}{.196 \times 7.122^2 \times .85} = 1.105 \qquad (6).$$

$$W = 2 \times .196 \times 7.122 \times 29.21 = 81.5 \qquad (4).$$

$$N = \frac{4.05 \times 3{,}220}{81.5} = 160 \qquad (7).$$

$d^2 = 2 \times 3{,}220 \times 27/4.05 = 43{,}000$ (8). No. 4 B. & S.

$$P = .5 \frac{3.22^2 \times 24.8}{.196 \times 7.122} = 92.$$

ERRORS.

In t, + 2¼%; in N, zero; in d^2, — 3%; in P, + 2%.

EXAMPLE III.

$D = 4.15$; $l = 4.25$; $t = .93$; wire, No. 18 B. & S. s-c-c to .0443; $NI = 1{,}915$; $N = 2{,}000$; $I = .96$; $R = 20$; $E = 19.2$; $W = 18.45$; $S = 85$; $w = .217$; $P = 13.5$.

VALUES OBTAINED BY FORMULA.

$$t = \frac{.9 \times 1.915^2}{.217 \times 4.25^2 \times .85} = 1.00 \qquad (6).$$

$$W = 3.142 \times 6.15 \times 4.25 \times .217 = 17.8 \qquad (4).$$

$$N = \frac{19.2 \times 1{,}915}{17.8} = 2{,}065 \qquad (7).$$

$$d^2 = 3.1 \times 1{,}915 \times 5.15 / 19.2 = 1{,}590 \qquad (8).$$

$$P = \frac{.8 \times 3.68}{.217 \times 4.25^2} 4.15 = 13.25 \qquad (11).$$

ERRORS.

In t, + 7¼%; in N, + 3¼ %; in d^2, — 2¼%; in P, — 1¾%.

These examples, which were chosen absolutely at random, show what accurate results these approximate formulæ give, and long experience has shown that such accuracy is to be expected under most ordinary conditions. This is evidently ample for the conditions obtaining in practical work, since it is seldom possible to predetermine the ampere-turns or coil dimensions with any such accuracy. It must be remembered, however, that the care with which the coil is wound may have an appreciable effect on the results obtained.

Certain approximate laws, which are of assistance in preliminary design, are simply deducible from these formulæ. Thus, when coil space is limited, the depth of the coil is often an important factor and equation (6) shows that this varies practically with the square of the ampere turns and inversely with the watts per square inch and the square of the length of the coil. Equation (7) shows that the number of turns varies directly with the ampere-turns and the impressed e.m.f. and inversely with the I^2R loss in the coil and is independent of the shape of the coil and the size wire, except inasmuch as these factors affect the I^2R loss. Equation (8) shows that the circular mils in the wire used varies directly with the mean length of a turn and the ampere-turns and inversely with the impressed e.m.f. Finally, equation (11) shows that the weight varies directly with the square of the ampere-turns and inversely with the watts per square inch and the length across wires. Equation (11) is especially valuable in preliminary designs, since it enables the designer to quickly determine the weight of copper in the coil and the changes in weight due to changes in design, without going through the tedious calculations for determining the number of turns and the size wire.

I have not attempted to give any definite value for w, since it will vary with every type of machine and even with different sizes of the same type. Where there are no experimental data to go on, it may be taken to range from .5 to .75 for a rise of temperature of 40° C. These values are for machines that are not enclosed.

The Price of Gas at Peoria, Ill.

Because of an ordinance passed by the City Council of the City of Peoria on September 4, 1900, which provided that the maximum rate thereafter to be charged by any gas company doing business in the City of Peoria, should be 75 cents per thousand cubic feet, that the gas furnished should be of uniform 18-cp illuminating power at the point of consumption, and heavy penalties for violation of the ordinance, the Peoria Gas & Electric Company secured a temporary injunction against the enforcement of the ordinance, and thereupon instituted suit. The case was bitterly contested for more than 18 months, testimony of distinguished experts from all over the United States being adduced by both parties. The decision has just been handed down by special master in chancery I. C. Pinckney, named by Judge Humphrey, of the United States Court. The master's findings, which are of especial interest, are as follows:

First. That the exercise of the right claimed by the city must be reasonable.

Second. That the question of the reasonableness of such a right is for judicial determination; that is, that neither the city nor the legislature of the State itself has the right to fix a rate in such a manner that the courts cannot inquire into its reasonableness.

Third. That in determining the cost of the manufacture and distribution of gas, the depreciation of the plant and a reasonable interest on the money invested are proper elements in such cost.

Fourth. That a Federal question is clearly involved; because under the facts in evidence the enforcement of the ordinance would necessarily amount to a taking of the complainants' property without due process of law.

Safety Devices in Central Stations and Sub-Stations.

MR. Philip Torchio, in his paper with the above title, read before the April meeting of the American Institute of Engineers, gave the following list of characteristic features more or less generally adopted or considered desirable for insuring reliability of central station operation. While some of the safeguards given in the list may appear unnecessary and expensive refinements, and probably would be such for a large number of cases where continuity of service may not be considered absolutely essential. In the case, however, of the lighting and power of a large city, the conditions are different; and if for these conditions safety cannot be obtained in any other manner, refinements become of paramount importance.

GENERATING STATION.

1. Installation of storage battery on field exciter bus, at generating station.

2. Equipment of reverse current relays and circuit-breakers on exciter generators.

3. Equipment of overload relays with time limit and circuit-breakers, on motors of motor-generator exciter sets.

4. Separation and mechanical protection of generator leads of different generators. Also proper insulation and protection against capacity discharges of cable leads.

5. Connection of each generator to bus-bars by means of two oil switches in series, preferably arranged to close independently and open at the same instant.

6. Subdivision of bus-bars, in different sections, enabling operation of generators in different groups. Also selector switches on each generator, enabling the same to be operated on at least two sections of bus-bars.

7. Tie connections between different sections of bus-bars, enabling us to make, if desired, combinations of different sections or even one common bus-bar.

8. Overload and reverse current relays on generator switches, these being connected to signal lamps until they have proven their reliability for actual tripping of main switches.

9. Selector switches on feeders providing means of connecting each feeder to at least two selectors of bus-bars.

10. Duplication of oil switches on each feeder circuit, preferably arranged to close independently and open at same time.

11. Overload relays on each feeder, with a variable time limit, in inverse proportion to the amount of current.

12. Separation of all wiring and busses inside the station by means of ducts, fire-proof septums and grooves in walls, and proper protection against capacity discharges, by the use of good glass or porcelain insulators.

13. In connection with very high-voltage step-up transformers, provide low-tension synchronizing busses for generators and switches on the l.t. side of step-up transformers, thereby avoiding synchronizing on the h.t. side of transformers, or closing of h.t. switches on dead transformers.

14. Avoid installation of single-pole main switches for each phase of the circuit, and also synchronizing with one pole switch closed and synchronizing transformer across the gap of the other pole switch.

TRANSMISSION LINE.

15. Duplication of transmitting lines to important centers of distribution, selecting if possible different subway routes, or independent transmission lines.

16. Mounting of suitable end boxes on ends of cables at all terminals. Also possible equipment of spark arresters on each end of underground cables.

17. Protection of underground cables in ducts by the use of good fire-proof material.

18. Protection of cables in manholes, using preferably separate manholes for high-tension cables, with asbestos or iron covers on each cable, etc.

19. Protection of lead sheath of cables against electrolysis, either by laying cables in vitrified ducts and rubber-cushioned racks in manholes, thereby making the cable insulated from ground along its route, or laying heavy bare copper wires along the route of cables and connecting solidly to their lead covers in each manhole, these wires providing a secure metallic path for the current, which leaves the cable sheaths to return to the grounded bus at the railway station

via the wires suitably connected to the railway return feeders.

20. Protection of transmitting and receiving stations operating overhead transmitting lines by improved lightning arresters.

21. Grounding of neutral of three-phase transmission lines for very high voltages. (General practice in the California transmission plants.) In the case of very high voltages, this grounding seems a necessity.

22. Possibly grounding of neutral for lower voltages and underground cables. (This is done in several places, as for instance, in Chicago, on the 2,200-volt, 3-phase, 4-wire, 60-cycle system, as well as on the 9,000-volt, 3-phase, 25-cycle, star-connected system.) From the point of view of reducing strains on insulation, this grounding of neutral seems unnecessary for moderate voltages, though it could be made use of for locating accidental grounds on the system, and in indicating and eventually disconnecting the affected feeder, which would be troublesome to locate on a system without grounded neutral and operating several feeders from same bus-bars.

23. Avoid operation of high-tension lines at different frequencies when lines are mounted on same pole line. This to avoid doubling of strain on insulators when two wires of different lines become crossed.

SUB-STATIONS.

24. Separate lines entering sub-stations should preferably be operated independently, laying out independent h.t. busses and transforming apparatus on each line, the transformed current being delivered either to a common set of bus-bars or to independent sets of bus-bars, if the service will allow of this subdivision. In rotary sub-stations, while the rotaries operate in parallel on the direct-current side, they can be fed from independent h.t. lines not operated in synchronism. This allows feeding each sub-station from different groups of generators at the generating station, or even from different generating stations. In the case of alternating-current stations with transformers feeding into a common secondary set of bus-bars, the primary lines must necessarily be operated in parallel, and therefore from same bus-bars at the generating station. This prevents us from attaining the advantages of duplicate lines and independent sources of supply, as in the case of rotary sub-stations. For this reason, in alternating-current systems of secondary distribution, as extensively used in water power plants, the adoption of independent groups of generators and independent feeding lines to important centers of distribution is not common. In important cases it may be advantageous to subdivide the customers' supply on different circuits fed from independent lines and transformers operated from different sources of supply. The New York Edison Company operates at present the generators at its Waterside station in two independent groups and whenever a sub-station has more than one rotary converter in service, the several rotaries are divided among different feeders, fed from different groups of generators at the generating station. The rotary converters being operated in parallel on the direct-current side, the distribution of loads between different feeders and consequently between groups of generators is easily and perfectly accomplished. This distribution is regulated by the system operator at the station, who instructs each sub-station how to subdivide the loads among the rotaries. The system is laid out to still further subdivide the groups of generators, if the further addition of generators will make it desirable.

25. Receiving lines should be equipped with oil switches and overload relays with variable time limit in inverse proportion to amount of current. When more than one line is feeding a common h.t. bus or independent transforming apparatus operating in parallel on the l.t. side (for instance, rotary converters), each line should also be equipped with reverse-current relays, with variable time limit in inverse proportion to the amount of current, the time limit for these relays being a fraction of the time for the overload relay. Reverse-current relays without time limit are too sensitive to momentary irregularities on h.t. system and cause trouble on this account.

26. Inside the sub-stations all h.t. wiring and construction should be laid out along the same lines mentioned in case of generating station. Also, the low-tension apparatus and connections should be properly laid out, avoiding crowding and crossing of cables, keeping cables of different polarities separate, and protecting them by means of ducts, septums and pipes as much as possible.

26a. On very high-voltage receiving stations, the closing of h.t. switches on transformers subjects them to heavy strains which can, in most cases, be avoided by making alive the transformer from the low-tension side, if the common bus-bars are already fed from another set of transformers. In case of a single set of transformers, it may be advisable to leave the high-tension side of transformer closed all the time, especially in water power plants.

27. For protection of lines from overloads or short circuits on transforming apparatus of large capacities, oil switches with overload relays should be considered preferable to h.t. fuses. The switches should be of proper capacity and should be equipped with locking relays for overloads, exceeding the safe breaking capacity to avoid blowing up the oil switch. The breaking capacity of an oil switch will to a great extent depend not only on the character of load, but also on the amount of power back of the short circuit.

28. Compound-wound rotary converters and eventually also plain shunt-wound rotary converters operated in parallel on a common direct-current bus should be protected by some speed limit device to trip the alternating-current and direct-current circuit-breakers on the rotary, when speed exceeds the normal by a certain fixed percentage. The sample here shown is a speed limit device developed by the company with which the writer is connected, in conjunction with a firm which manufactures measuring instruments; adopting their standard mechanism for speed indicators.

29. It is desirable to protect the direct-current side of all rotary converters with circuit-breakers to operate in connection with the speed-limit device above mentioned, and also in connection with a reverse-current relay on the direct-current side of the rotary. This reverse-current relay should be equipped with a variable time element in inverse proportion to the amount of reverse current; direct-current overload relays seem to be unnecessary.

30. All relays at different points of the system and their time elements must be properly adjusted, to operate the different circuit-breakers in the proper order, so that if a trouble is once cleared by the opening of certain circuit-breakers, the other relays reset themselves in the normal position, leaving the rest of the system in operation.

31. Emergency connections between different generating stations are considered desirable and have found favor in connecting different water power plants and also in connecting large generating stations in the same city, as in New York.

32. Of first importance in a lighting situation in a large city is the equipment of storage batteries at every sub-station. One large New York company, for instance, has installed or under contract twenty-two 8,000-amp-hour, 135-volt batteries, and more may be installed in the future.

33. In closing this list of safeguards, it may be added that in all high-tension work great care should be used in applying tests to the apparatus, especially in making insulation tests on generators, cables, line and transforming apparatus. Break-down tests can be made on samples, but it is unwise to strain unnecessarily the insulation of the complete plant near the break-down point. Close inspection of the installation will finally give more satisfactory results than loose inspection and severe tests.

Wireless Telephony on Ferry Boats.

BY A. FREDERICK COLLINS.

The results of my experiments in wireless telephony at Narberth, Pa., and at the proving grounds at Rockland Lake, N. Y., last summer have been published in prior issues of ELECTRICAL WORLD AND ENGINEER. These tests were the means to an end or rather means to the beginning of the end, for the test, last week, on the North River between the ferryboats *John G. McCullough* and the *Ridgewood,* both of the Erie Railroad system, were but the merest beginnings of what, I sincerely hope, the wireless telephone may come to be. Heretofore the question of what constituted a commercial wireless telephone has proven a stiff one, for the engineer as well as for the layman. To even a novice in the art, it was evident that its field was not to oust the efficient wire system now in use, any more than the wireless telegraph will supplant the wire system. Converting an experimental product into one of commercial utility does not necessarily mean the perfection of it first, and the application of it afterward, but in some, and in many instances a sphere of usefulness may be found in which the immediate utilization of it is of more use than a toy, and as it matures it will expand and fill the larger needs of practice.

This was my idea in the incipiency of the system under consideration. If I could not invent a system that would at once transmit articulate speech without wires a distance of ten miles, I could apply

a method that would operate a thousand feet. Vessels in harbors offered exactly the ideal place, and hence the tests just made. To those persons who make an occasional trip across the river by ferry, the uses of a wireless telephone as a safety device will not be at once apparent, but to commuters who make round trips daily, for example, across the Hudson and East Rivers, New York, the fact that their lives are absolutely in the hands of the man in the pilot house is deeply impressed upon their minds.

There, high above them, the pilot scans, not the horizon nor even the sky line of the buildings, but the *first few hundred feet* ahead, keeping eyes and ears alert for a light, or a sound of another vessel—all of which is easy in the bright light of the day or even the darkness of the night if it is clear.

FIG. 1.—WIRELESS TELEPHONY ON FERRYBOATS.

But in a fog all this security is eliminated. It is impossible for a pilot to see the bow of his own vessel, much less a silent, moving craft, which may be running him down amidships. In foggy weather, whistles are sounded every fifteen seconds, but while a pilot may gain a fair idea of the position of another vessel by the blast of its whistle, it gives absolutely no indication of the direction it is going.

FIG. 2.—WIRELESS TELEPHONY ON FERRYBOATS.

It is here that the wireless telephone may prove of greatest service. When two vessels approach within a certain range, the captains can converse with each other and by each stating their position—by the compass—and their route all danger of collision should be avoided. This is only one of its many uses.

The reason the wireless telegraph is not as serviceable at close range as a wireless telephone is because it must be operated by expert telegraphers, whereas the wireless telephone can be used by any person. Where the distance between vessels is limited and their movements are unknown, there is no time for translating messages; in other words, the wireless telephone is a first-hand instrument.

The tests were limited in distance to 600 or 700 ft. for the reason that only a small piece of copper tubing was used to earth the wires, whereas large surfaces should have been employed. The effective distance may be increased. At Rockland Lake a mile was covered under favorable circumstances and this may be repeated between boats with some experimenting. The distance I desire to attain is that sufficient to insure the prevention of collisions of vessels in harbors during bad weather, and with this idea in view I hope my system will act as a sort of condition of marine block signal system between ship and ship, or ship and shore.

Operation of Berlin Electric Roads.

A report from the United States State Department on results with the new electric roads in Berlin says: "The elevated and underground electric railway built by Messrs. Siemens & Halske, and opened for traffic in February, 1902, has proven a remarkable success, and after a single year of service has become the most popular of all interurban routes of travel. It carries passengers a distance of 3 miles in 10 minutes for fares ranging, according to the class of the car, from 2½ to 3¾ cents. Its traffic and earnings exceed by 80 per cent. the estimates of the builders when the enterprise was planned, and it has demonstrated that any device of reasonable cost, which is well equipped, safe and capable of shortening the time of transit between different portions of the city, will be promptly and liberally patronized. In one respect only the new line has encountered some difficulties. When the franchise was granted, it was necessary to obtain the consent of property holders in certain streets where overhead construction was to be used, and to these the promise was made that the jar and noise of passing trains would not be objectionable. But it is in practice very difficult to run a rapid train of three eight-wheeled cars over a track laid on aerial framework of steel without causing a vibration and resonance that may be disturbing to nervous people in adjacent buildings. So the new company found itself attacked in the courts and had to resort to all practicable means of deadening the vibration and reducing the noise of traffic. These experiments included, first, inserting three layers of felt between the rails and the wooden ties on which they are laid. This made some improvement, but did not satisfy the complainants nor the police. Next, in place of wooden sleepers, hollow iron girders were put beneath the rails and filled with loose sand, which, it was expected, would take up the vibration and thus deaden the shock. This, also, has been found partially effective, but not wholly satisfactory. A third plan has been to abandon the use of cross ties and instead lay the rails on long longitudinal wooden sleepers, with cushions of lead laid beneath the rails. Finally, the car wheels have been in some way lined with wood, so as to break the continuity and consequent resonance of a metallic structure. All these experimental remedies are still on trial, but no definite conclusion concerning them has been announced."

Postal Trolley Cars.

In accordance with a resolution passed at Pittsburg on May 8 by the Amalgamated Association of Street Railway Employees a telegram was sent to President Roosevelt, asking him to intervene to prevent the unlawful use of the United States postal system to hurt this union. Grievances were alleged by delegates because of the manner in which the United States mails were used in San Francisco and New Orleans during the time that the street car men were having trouble with their employers on account of organizing divisions of the union. The absurd assertion was also made that in San Francisco the letters of the street car men were held up, that some letters were opened and photographs were taken of the contents, and in many cases these photographs were posted by the employers at the various car barns. This was done, it is alleged, in order to deter employees from joining the unions. In New Orleans similar methods were alleged. It was also charged that during strikes street railway companies placed United States mail signs on cars not carrying mail, contrary to the ruling of the Postmaster-General, for the purpose of coercing the employees.

The Storage Battery in Transmission Plants.

BY H. S. KNOWLTON.

FROM the earliest days of electric power transmission, continuity of service has been one of the prime requisites of commercial success. As the amount of power, voltage and distance of transmission has increased, the necessity of continuous and reliable service has become imperative. Given a great hydraulic electric plant transmitting thousands of kilowatts at potentials like 50,000 volts to points within a radius of 100 miles, it is self-evident that even a momentary interruption of service is fraught with the most disastrous possibilities, not only in heavy financial loss, but in danger to human life itself. The loss of time incurred in the shutting down and starting up of scores of factories, railway and lighting sub-stations, the possible ruin of electrochemical products, stopping of cars on railroad crossings, and the panic and confusion incidental to the sudden momentary triumph of darkness in theatres, concert halls or churches supplied with power through the central generating plant are difficult to measure in dollars. The loss of prestige which frequent shut-downs entail spells "ruin" in capitals if the situation is not bettered. Apparatus and devices which stand between steady continuous operation and temporary shut-downs are, therefore, worth the careful consideration of the progressive manager.

The use of the storage battery as a reserve in connection with the exciters of the alternators in large transmission plants is growing to be an important additional safeguard against break-downs. Normally it will float on the bus-bars while the exciters supply current to the alternator fields, stepping into harness and picking up the load instantly if the exciter voltage fails, in its rôle of "watch dog of the system." Ordinarily an exciter is regarded as a thoroughly reliable and staid piece of machinery, capable of operation on the continuous performance plan, and in many installations the provision for duplicate machines has been considered sufficient precaution against interruption. In the great modern installations above referred to, however, it is vitally important that anything in the nature of an interruption be absolutely prohibited. Every user of power from the housewife with her motor-driven sewing machine and the dental surgeon with his tiny mouth lamp to the stockholder of the largest factory or street railway system has the right to demand that the power paid for be made as nearly continuous as human knowledge and skill can insure it. The operation of the storage battery in connection with the exciters is best illustrated by a typical case.

Assume two 150-kw, 125-volt exciters in the plant, each being of sufficient capacity to supply field current to 17,500 kw in alternators at 80 per cent. power factor and 25 per cent. overload. We require 1,200 amp. at the exciter bus-bars in order that the system shall operate within certain specified limits of regulation. To supplement this installation, we add a reserve battery capable of discharging at the rate of 1,200 amp. for one hour, or 300 amp. at the 8-hour rate. A 70-cell battery is required, with two 20-point end cell switches. At 2.5 volts per cell the battery calls for a maximum of 175 volts when being charged with all the cells in series. If the exciters are capable of being driven by the turbines at 40 per cent. above normal speed, we shall obtain 175 volts, when using one of them for charging purposes.

When the battery picks up the load its voltage drops below 125 by an amount depending upon the discharge required. If, for example, the exciter bus load were 1,000 amp., the voltage would probably drop to about 118, remaining near that point until the station attendant can move the slider on the end cell switch to cut in more cells, thereby raising the voltage to 125. If the battery is called upon from time to time to maintain this rate of discharge, the end cell switch slider must be gradually moved up in order to maintain the voltage. Probably 60 cells would be the average connected across the exciter bus-bars.

Charging is accomplished by one of the exciters through the end cell switch connections, a double-throw switch being arranged to connect the positive terminal of any exciter to either the positive exciter bus or the end cell switch. As the battery charges, the end cells are gradually cut out of circuit by the attendant in order to keep the bus voltage at 125. If the charging current fails when nearly all the end cells are cut out, the battery would be charged at a lessened rate from the exciter bus-bars until the slider was moved to cut in the proper number of end cells to balance the battery and bus voltages. If the voltage of both the bus-bar and the charging exciter gives out during the charging period the battery voltage will fall off somewhat as the load is picked up, but the drop will not be great enough to cause any discontinuity in the field current of the alternators. The transfer of the exciter bus from one to another end cell connection is effected without break or short circuit by the construction of the slider. This is divided into two parts separated by a resistance, and one or both adjacent end cell connections are always covered. The resistance is low enough in value to prevent any serious diminution of the entire battery current, while it effectually prevents the short-circuiting of a single cell in the brief time during which two adjacent connections are spanned by the slider.

In large plants the end cell switches would preferably be motor-driven and operated by remote control from the main manipulating switchboard. The battery finds additional usefulness in operating miscellaneous direct-current motor and lighting circuits of the traveling crane and other auxiliary apparatus, and in the starting of the plant when the exciters are driven by alternating-current motors. It also assists materially in preventing or reducing the fluctuations of alternating-current voltage, which are often aggravated by corresponding fluctuations of exciter voltage and current if there is no battery installed.

In round numbers, such an installation would probably cost something like $17,000, and its proportion to the cost of the entire hydraulic and electric plant would be but one or two per cent. As a safety adjunct its value can best be determined by those who have had the experiences resulting from shut-downs as outlined above.

Heating of Electrical Conductors in Liquid Baths.

Prof. Charles A. Perkins has conducted a series of experiments with a view to obtaining constants applying to the dissipation of heat from bare conductors immersed in liquids, an account of which is printed in the University of Tennessee *Record*. Nine coils of iron wire were connected as indicated by the accompanying sketch. The current enters at *A*, one-third going by the path *A, D, B*, and two-thirds by the path *A, C, B*. At *C* the portion *A, C, B* divides and one-half goes by each path indicated. By this arrangement the coil, *A, C*, is heated four times as much as *C, B*, the coils, *A, D, B*, acting as the two arms of a Wheatstone bridge. Part of the wire near *D* is left straight, and a sliding contact, connected with a galvanometer can be adjusted to balance the heating of *A, C* by the current.

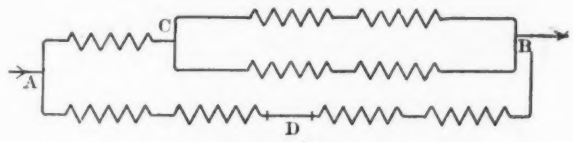


DIAGRAM OF CONNECTIONS OF COILS.

The wire was coiled into a helix and soldered at all joints. Wires from the same piece were brought from *A* and *B* and connected to the leads of a dynamo. The coils, *A, C* and *C, B*, were mounted vertically in a wooden frame and submerged in a jar of kerosene, and the balancing coils similarly mounted and submerged in a larger jar of kerosene, as close as possible to the first jar. The sliding contact at *D* is moved by a vertical screw, the upper end of which projects above the oil. The whole number of turns of the screw are counted by a toothed wheel, the fractions of turns being estimated. The screw has 17 threads to the inch. The sliding contact at *D* was soldered to one galvanometer wire, and to avoid thermo-electric currents, an iron wire from *C* was carried over into the second jar and soldered to the galvanometer wire near *D*.

The current was furnished by a storage battery or by a 125-volt dynamo, controlled by a bank of lamps and was measured by a Weston millivoltmeter and shunt. The current is assumed to divide between the different circuits in the ratio indicated, although the coils are adjusted to equality only by counting the numbers of turns.

The kerosene in the jar containing the balancing coils, *A, D, B*, was kept continually stirred by a fan on the shaft of a small electric motor. That in the other jar was stirred in some experiments and not stirred in others. The four spirals in *B, C* were distributed about the coil, *A, C*, and were 1 cm to 2½ cm distant from it. Any difference between the temperatures of these coils is no more than would be found between the conductor and a thermometer which

would be assumed to give the temperature of the conductor, and any upsetting of the balance on passing a current through the network was due to the fact that the wire carrying the stronger current had not the temperature of the bath near it. To determine the amount of heating from the change in the resistance, the temperature coefficient of another sample of the same wire was determined. The stirrer employed was an annular strip of vulcanized fibre on the end of a wooden rod, and extended about three-fourths around the central coil, *A, C,* so that when drawn up and down by the hand it caused a fairly rapid circulation of the liquid close to this coil.

Prof. Perkins, in giving the results of his experiments, makes a comparison with results reported by Dr. Lindbeck, of the Reichanstaldt, in a set of similar experiments. In these latter, 0.1 watt per cm^2 raised the temperature 1.1° above the bath. The heating was not proportional to the watts, being less for higher currents. Stirring was of little or no advantage.

In Prof. Perkins' experiments, .01 watt per sq cm raised the temperature 1.03° above the bath when the latter was not stirred. The heating, so far as observed, was proportional to the watts. Stirring increased 17 times the number of watts dissipated with a given elevation of the temperature of the wire above the bath.

In his experiments Prof. Perkins calculated the total surface of the wire, while in the Reichsanstalt experiments the surface was taken to be that of the cylinder upon which the wire was wound. That the heating was found in the Perkins tests proportional to the watts dissipated may have been due to the small range of temperature employed or to the fluidity of the oil, which was ordinary illuminating oil, whose flashing point is about 200° F. The marked difference in the effect of stirring may be due to the fact that the coil was an open helix, so that on stirring a very free circulation of the liquid took place, as compared with what would result in a coil wound on a metal cylinder. It was frequently noticed that when a current upset the balance enough to swing the mirror of the galvanometer far off the scale, a few strokes of the stirrer would bring it back nearly to its zero position. In conclusion, Prof. Perkins states that the absolute value of his results applies only to the coils actually used, which were of the following dimensions: Diameter of wire, .015 cm; diameter of coils, 3 cm; number of turns per cm (about), three and one-half; watts per sq cm to cause a heating above the bath of 1° C., bath stirred, .1280; bath not stirred, .0077.

Electricity and Seismic Phenomena.

Prof. E. Pilsudski, in the March issue of our Russian contemporary, *Electritshestvo,* discusses the connection of electricity with seismic phenomena. That seismic disturbances are accompanied by electrical manifestations has, he says, long been known, and was recently strikingly confirmed during the volcanic eruptions at Martinique. It was then observed that several minutes before the destruction of St. Pierre, telegraphic operation between the former and Fort de France was interrupted, owing to the passage of earth currents in the telegraph wires; the same occurred at Nice during an earthquake there on February 23, 1887, as well as other places. Some scientists, among others the late Gaston Planté, have held the opinion that seismic disturbances are produced by subterranean disturbances, in which electricity is the main factor; in other words, that they are the result of electrical discharges between strata of good conductivity separated by other strata of negligible conductivity, such as granite and silica. The discharges of such earth condensers generate great quantities of gases and vapors and these under great compression produce during expansion disturbances in the direction of less resistance; that is to say, radially toward the surface. In some instances the center of the disturbances has been located at not very great depths beneath the earth's surface, as in the case of the eruption on the Ararat. In these cases, the earth's surface was opened at many places and stones, vapor and mud escaped through the crevices. In some other cases, the gases escaping at the earth's surface produced intense fogs, and the air was filled with ozone—an evidence of electrical discharge—as occurred during the earthquake in Calabria.

Prof. Pilsudski considers that in addition to strong disturbances occurring at rare intervals, feeble electrical discharges are probably constantly occurring in the earth, and he suggests that a systematic study be made of the subject, particularly in regions where there are dip pits, as in the Transvaal and Caucasus mining regions.

Chicago Discussion of Central Station Tendencies.

At the meeting of the Chicago branch of the A. I. E. E. on May 5, the papers on "Tendencies of Modern Central Station Development," which had been presented at the New York meeting of April 24, came up for discussion. Mr. Peter Junkersfeld, recently elected local secretary, presided. A well-attended meeting attested to the importance of the subject and the great number interested in this branch of electrical engineering. The papers were abstracted, that on "Economical and Safe Limits in Size of Central Stations," written by H. A. Lardner, by Prof. P. B. Woodworth, that on "Safety Devices in Central Stations and Sub-stations," by Philip Torchio, by W. G. Carleton, and that on "Multiple versus Independent Operation of Units and Central Stations," by Peter Junkersfeld, the writer, himself. The discussion, which was participated in by many, brought out several important points, both in the construction and the operation of power plants.

Bion J. Arnold stated that he had always been inclined, as was well known, to the use of a single power house where this could be properly located as regards the supply of fuel, water, etc., with substations operated by rotary converters. As regards the use of motor-generators versus rotary converters, European practice seemed to be the opposite of ideas generally accepted here. On a recent visit to Frankfort, Germany, he saw in operation a 1,000-kw motor-generator set. The motor was a single-phase one, although he had been assured previously that such a size was not feasible. Those on the continent claim that a better efficiency can be obtained from the motor-generator combination, or at least as low a cost of operation, as with rotary converters. This is because the generators are wound for a high voltage, and the motors work at the same potential, thus obviating the first cost—the expense of operation, the complication of step-up and step-down transformers and the necessary auxiliary apparatus.

As to the supply of current to a long line of railroad, he had modified some of his previous views as to the desirability and economy of one large alternating-current power house for a long length of road and had been forced to the conclusion that for a railroad with heavy traffic, a number of direct-current power houses scattered along the line were best.

W. L. Abbott, chief operating engineer of the Chicago Edison Company, called attention to an important problem in central station operation. To the operating man, a single day's supply of coal for such a plant involves no little thought. The supply of 1,000 tons of coal a day, as for instance to the Harrison Street station of the Chicago Edison Company, is no small matter. He called attention to the different operating conditions resulting from the use of different methods of handling coal which had been introduced successively as the output of the former station increased. At first fuel oil was used. Then coal, which was brought to the boiler room in wheel barrows. This was followed by the dump cart drawn by a horse, which in turn was superseded by the tramway and push car. All of these different methods have given way to modern coal-handling apparatus. When one considers that under the first method the cost of handling a ton of coal was approximately 40 cents, whereas now it is between 15 and 20 cents per ton, although this amount is still far greater than it ought to be, this will be seen to be an important item, especially when one considers that the daily average consumption is 600 tons. A saving of 10 cents per ton would be a material one, and is very satisfactory indeed when the amount handled is considered. The continuous supply of coal for one of the large modern central stations becomes a serious problem when one considers that the consumption of 3,000 tons of coal per day is the equivalent of two train loads. In large cities, where the congested condition of tracks causes irregularity in supply, no reliance can be placed upon the railroads. This irregularity of supply is further increased at the mines. As a station must be operated continuously, regardless of any irregularity in the coal supply, it becomes self-evident that ample facilities for the storage and the handling of coal must be supplied, and the advisability of the company having special terminal facilities as well as owning its own cars is not to be disregarded. It is self-evident that the handling of such a large amount of coal and ashes by hand is impossible, and that apparatus must be installed obviating the handling of the coal by workmen, not only because of the decreased cost, but also because it reduces the number of employees, and what is still more important, the possibility of trouble because of labor agitation. In cities where several power

houses are located it is most economical to operate one large power house only.

Storage batteries are valuable adjuncts for these, as they meet sudden demands for power made on the power house because of sudden changes in the weather or because of a break-down at some station. The same may be accomplished to some extent by hand-fired furnaces, but this is impossible with automatic stokers. A great many power houses are now being built with apparatus for producing forced draft, as the draft may suddenly be doubled or even quadrupled, and the output increased to that extent, otherwise there would be a serious drop in the steam pressure where such a sudden demand is made. As a general thing, it may be said that the most wasteful and most extravagant piece of apparatus and the one which receives the least attention, is the boiler. At times a waste as much as 50 per cent. of the fuel used can be charged to the boiler, although half of this is quite readily prevented. As a consequence, it is necessary that the operating engineer give the closest attention to the boiler room. This is quite apparent in a plant consuming $3,000 or $4,000 worth of fuel a day, as a saving of 5 per cent. would be of great interest to those paying the bills.

In a general discussion which followed, Mr. Junkersfeld called attention to a number of interesting points which had been brought out in the discussion. He said that he was very much interested in the remarks made by Mr. B. J. Arnold concerning his conclusions that for railroad operation the best plan was to have direct-current power houses at frequent intervals rather than large alternating-current stations every 20, 30 or 40 miles, depending upon the size of the plant. It seemed to him that in the case of such plants, the element of unproductive investment and of unproductive labor would make it desirable to have as few a number of these as possible, provided they were located within the economical limits of voltage and possibly it would be well to have the plants further apart. He also called attention to the fact that the boiler room was not receiving its due share of attention as regards either design or operation. The boiler room investment amounted to quite an appreciable percentage of the total amount. Another important point in central station design which had been brought out in the discussion was the fact that storage batteries, although having a field of their own, could be superseded to quite an extent by the judicious use of forced draft in the boiler room. Quite an appreciable amount of storage battery capacity could be obtained at a reduced cost in this manner.

H. B. Gear, general inspector of the Chicago Edison and the Commonwealth Companies, called attention to the question of isolation or central control carried out through the 60-cycle distributing systems of both companies. The average feeders are carried along different routes, so that in case of trouble at any one point, other sections of the city are not affected. The same is true with the secondary system. Each transformer supplies a separate secondary system. The main secondaries are not more than 500 or 800 ft. long, and are supplied by two or three transformers at the most.

W. G. Carleton, assistant to the chief operating engineer of the Chicago Edison, discussed the troubles he had experienced on the 25-cycle distribution system. His experience had been the same as that of Mr. Torchio. Three-quarters of his trouble have occurred in the station, and were mechanical. The faults on the 9,000-volt lines were not due to any inherent weakness, but rather to mechanical injuries. He considered it advisable to separate the routes of different lines, even though they were operating in parallel at the stations. He referred to trouble which the company had experienced with currents going two or three miles along the lead sheath of the cables, and that this had been obviated by breaking the lead sheaths every half mile or so, and grounding them at the middle points.

J. R. Cravath stated that he had been impressed in looking over recent plans for turbine stations, with the enormous amount of boiler room required for one turbine unit. As one engineer had expressed it, power houses would almost have to be installed on the radial plan with the turbine in the middle. The relative location of boiler and turbine rooms to keep down the distances steam must be piped and provide for extension section by section on a uniform plan, is a serious problem in the design of such stations.

Bion J. Arnold, in reply to the remarks of Mr. Junkersfeld, then said that in advocating direct-current power houses located short distances apart, he had in mind heavy railroad service with trains requiring 1,500 kw, as for instance, on the New York Central.

The next Chicago meeting of the Institute, on May 19, will be devoted to papers and discussions by local telephone experts.

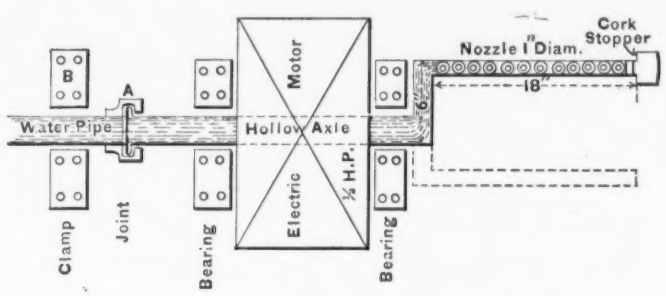
How to Produce Gravity Experimentally.

BY ROBERT STEVENSON, C. E.

THE experiment described below is offered as a challenge to the scientific world to prove by the accepted laws of motion how the helicoidal motion produced is possible in free space.

Take an electric motor of any power from ½ hp upwards. Substitute a hollow for solid shaft, from 1½ in. upwards. Over the hollow axle fit a bent nozzle, as shown (by screw or otherwise). At the other end of the hollow axle have a free union joint at *A*. At *B* have the connecting water pipe clamped fast. Have bearings for the motor as shown. Have a water pressure sufficient to force a jet of water through pipe and hollow axle and nozzle, with a constant velocity of 100 ft. per second. Have a stop-cock close to, but behind the clamp *B* (not shown).

First Experiment.—Use water only, without the lead balls and cork, as shown in nozzle below. Fill the pipes with water due to pressure against stop-cock, but keep hollow axle and nozzle empty of water. Start the motor, and keep rotating at 100 r.p.m. Then open the stop-cock and let water jet through the nozzle, at the same time increasing the e.m.f. to keep up 100 revolutions. As this requires



PRODUCING GRAVITY EXPERIMENTALLY.

a large increase of force, it requires a little practice. But as this experiment is only qualitative, perfection is not required.

I have found that to change the direction of momentum in this way requires power, although Kelvin, Tait, Maxwell and all the authorities deny it. That, in fact, is one of my discoveries. But if the rotation of the nozzle be kept up when the water is jetting through it at 100 ft. per second, the water after it leaves the nozzle describes a vortex, or corkscrew path in space; and that helicoidal path would continue forever, if there was no air or weight to affect it. That is how planetary systems are formed from rotating nebulæ.

Now empty the nozzle of water and place lead balls just large enough to fill the tube, as shown, and a stopper to hold them in place whilst the motor is rotating, before the water jet is turned on. When the water jet is turned on, the balls and stopper are projected into space, and the balls can be seen describing orbits round the axis of motion, or neutral line, without any attraction whatever; and that is how the planets move in their orbits in space, whilst the sun moves in the neutral line, or axis of motion that the water would have if it was allowed to project straight from the axle of the motor, which is the neutral line. And from that fact it is easy to calculate the sun's proper motion in space from a simple geometrical formula, without the use of the spectrograph. My rough calculation makes it about 13 miles per second. The same experiment can be made by using one ball and compressed air instead of water, provided the ball be given a longitudinal velocity of 100 ft. per second.

Owns a Coal Mine.

In a communication, Mr. George A. Hughes, owner of the Glendive (Mont.) Heat, Light & Power Company, writes us that he believes his to be the only electric light plant owning and operating a coal mine in the United States. The mine is located about 1½ miles from the station. The company owns 40 acres of land there and is now working in a four-foot vein. Eastern managers who have been "up against" the recent coal strikes and coal prices will rather envy Mr. Hughes, but few of them are in a position to duplicate his conditions, however much they might wish to do so.

New Telephone Patents.

From time to time there have been noted herein patents for various common battery circuit combinations in which two central batteries, both connected to the talking circuits have been used. These patents have been issued to various inventors all assigned to the Kellogg Switchboard and Supply Company. The fundamental patent for this double battery system, pending for some considerable time, has just appeared, being part of the issue of May 5, 1903. This patent has been granted to Mr. Kempster B. Miller.

All earlier central energy systems had used a single battery for furnishing talking currents, this battery being so connected to the lines through repeating or impedance coils that it provided current

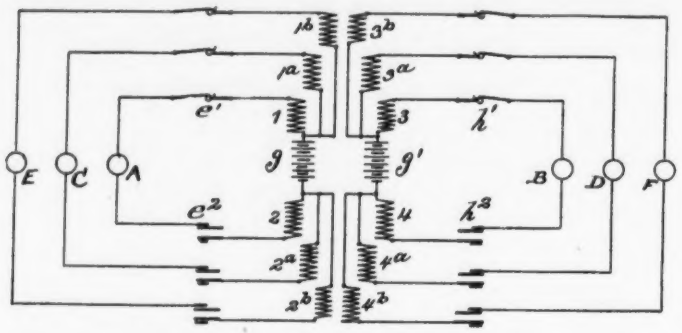


FIG. 1.—MILLER CENTRAL ENERGY SYSTEM.

indiscriminately to both calling and called for subscribers. Such systems are well covered by patents. Mr. Miller's system differs from these in the substitution of two central batteries, the circuits of the primaries and secondaries of the repeating coils being kept distinct conductively, one associated with each battery, and connected together inductively only.

The principle of this system is indicated in the diagram shown in Fig. 1. Herein *g* and *g'* are the two talking current batteries, to which are shown connected three pairs of telephone lines associated in inductive relation in pairs, by means of the several repeating coils. The windings, 1, 2, 3, 4, represent one such coil, 1 and 2 being the two parts of say the primary and 3 and 4 the secondary. When variations of resistance in the transmitter at station *A* cause corresponding variations in the current flow from battery *g* to the line, the resulting fluctuations in magnetization of the core of the repeating coil, 1, 2, 3, 4, induce co-ordinate varying alternating currents in the side of the circuit containing battery *g*, this battery acting solely as a conductor at this time. In Fig. 2 is shown one application of the system to practical operation. To the right and left respectively appear two subscriber's lines, while in the middle is shown a pair of connecting cords. The subscribers' signals are in circuit with both talking batteries, these being so poled as to their repeating coil connections that they may be used in series for signaling. The closing of the circuit between the two sides of the line at the subscriber's station causes the magnetic drop signal to fall. The signal circuit is wired to the line through a double cut-off jack and is, therefore, disconnected by the insertion of a plug in the jack. In its stead the repeating coil circuit is connected. As indicated in the figure, the repeating coil performs the additional functions of supervisory relays. To this end each end of the core con-

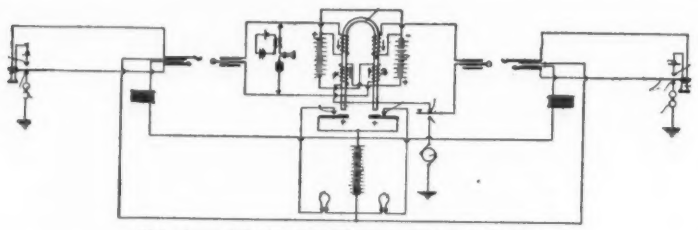


FIG. 2.—MILLER CENTRAL ENERGY SYSTEM.

fronts a relay armature controlling its own supervisory lamp circuit, the lamp glowing when the armature is attracted.

As in other common battery systems, for best operating conditions the glowing of one lamp is desired when a connection is partially completed, or when the attention of the operator is desired, and the glowing of both lamps, when disconnection is desired. These conditions correspond to two widely different conditions of current upon the two lines, and in order to provide for them the primary and secondary windings are each divided, one part of each being on each leg of the core. By connecting the windings on one leg in differential relation, when both subscriber's lines are receiving currents and these are substantially equal, a condition fairly obtainable in practice, the magnetic effect upon the core is nil. When the current in either line ceases both armatures would be attracted except for the fact that they are polarized in such a manner that the proper one only is attracted, the other being repelled. When both subscribers return their telephones to the hook, the two batteries acting in series send current through one-half of each coil and through the bells to ground, thus polarizing both ends of the core similarly and drawing up both armatures simultaneously.

A second very interesting patent of the issue of May 5 is entitled, "Means for Preventing the Disturbance of Telephone Circuits." C. J. A. Michalke is the patentee and he has assigned his patent to the American Siemens-Halske Company. The patent is most interesting to those dealing with grounded lines paralleling trolley or other power wires upon which an alternating weave is superimposed upon a direct current by the use of motors. In this system condensers are to be associated with the generator and with each motor to absorb the disturbing wave. Three methods of wiring the condensers are cited, these being shown in Fig. 3, *a* representing the generator, *d* the motors and *c* and *c'* condensers. In the first method these latter are connected directly to the machine terminals; in the second, the condenser is connected through the agency of a transformer; while the third is similar to the first except that an impedance coil has been inserted in the main line at each motor. It is difficult to state the merits of the various systems, but some experiments made by the writer some time ago would indicate that the

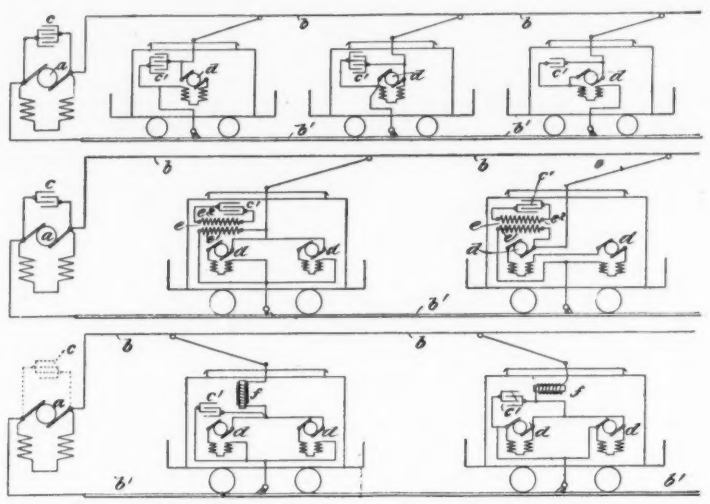


FIG. 3.—PREVENTING DISTURBANCE OF TELEPHONE CIRCUITS.

second system could be made very effective, especially if the transformer is of considerable impedance. It would even seem better to omit the condenser from the secondary entirely and to make the secondary of low resistance and short circuit it.

A third telephone patent of this week under the broad title, "Telephony," describes a "lock-out" party line system of unusual complication, a fault to which the failure of practically all previous "lock-out" systems has been due. This new system has been patented by W. E. Pembleton.

Two other telephone patents which have not as yet been noted are those respectively of C. W. Holtzer, entitled "Magneto," and of C. Van Riper, entitled "Telephone Pad." These patents both appeared in the issue of April 28. Mr. Holtzer's invention consists essentially of a clamp casting for securing in magneto boxes to support the rounded end of magneto permanent magnets so that they may be secure from disturbance during shipment or other rough handling. Mr. Van Riper's device is a shelf adjustable to the shelf of a telephone wall set carrying a roll of paper for memoranda, a straight edge for tearing off the paper and attachments for the directory and pencil. Mr. Van Riper also proposes to use the under side of the paper for advertisement purposes. This last seems hardly practicable as users would tear off paper in such irregular lengths that a confusion of matter would most likely occur at frequent intervals.

Recent Electrochemical Developments.

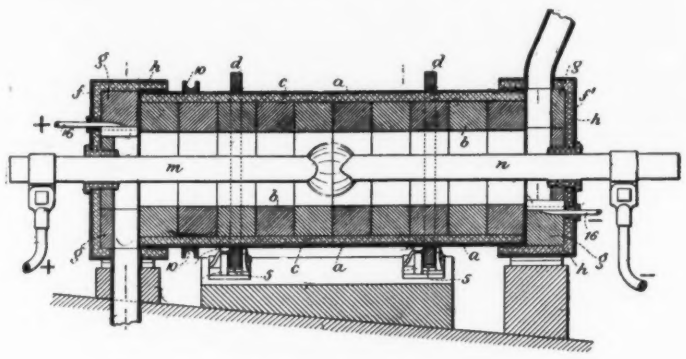
BY CLINTON PAUL TOWNSEND.

CALCIUM CARBIDE.

Mr. George E. Cox, of Niagara Falls, assignor to the Union Carbide Company, patents a method of converting such waste materials as the screenings and dust of calcium carbide and the partially converted material from previous furnace operations, into commercial ingots of carbide. Previous efforts along this line have not been lacking, but Mr. Cox now specifies the conditions which are essential to success. The refuse is of such high electrical conductivity that if it be attempted to fuse it under the conditions of the usual carbide furnace it is found that the heat of the circuit is not localized in the charge, but is, to a large extent, developed in the electrodes and their connectors. The proper conditions for the conversion comprise (1) the comparatively wide separation of the electrodes, in order to increase the resistance of the body of the charge, (2) the use of electrodes of high conductivity, as of graphite, and (3) a reduced voltage and increased amperage as compared with the values suited for the reduction of a mixed charge of coke and lime. Under these conditions this waste material may be formed into an ingot of carbide of commercial purity.

EDISON STORAGE BATTERY.

Recent patents issued to Mr. Edison cover a somewhat modified method of producing iron in an "electrolytically active" state, for use in his "reversible galvanic battery." The method consists in reducing finely divided oxide of iron, as ferric oxide, in a suitable retort by means of hydrogen at a temperature of about 900° Fahrenheit; some twenty hours are required for complete reduction at this temperature. The reduced iron is then permitted to cool to the normal temperature in an atmosphere of the gas, and is then flooded



LONGITUDINAL SECTION OF ELECTRIC FURNACE.

with water, after which it can be removed from the retort and handled without undue oxidation. The iron so prepared is mixed with flake graphite, or, preferably, with less than its own weight of copper or mercury. The form of battery which is the subject of the present patents, comprises this material, opposed in an alkaline electrolyte to nickel oxide.

ELECTROLYTIC REDUCTION METHODS.

A series of electrolytic reductions, occurring in acid solution in the cathode compartment of a diaphragmed cell are described by Dr. Julius Tafel, of Würzburg, Germany. The first of these is the production of hydroxylamin by reduction of nitric acid in sulphuric acid solution. The cathode is preferably, but not necessarily, of mercury or amalgamated lead, and the anode is of lead. The conditions essential to success comprise the maintenance of the temperature at about 20° C.; the thorough agitation of the cathode solution, and the gradual addition of nitric acid in quantity proportionate to the current used, that is to say, at such rate that the evolution of hydrogen at the cathode is barely noticeable. The method is claimed to be a commercial one, but efficiency data are not given.

Two new compounds which the inventor names, "Camphidon" and "Camphidin," respectively, result from the cathode reduction of imido-camphoric acid, $C_{10}H_{15}NO_2$. The reduction proceeds in acid solution, a lead cathode being employed with sulphuric acid or a tin cathode with hydrochloric acid. Camphidon, having the empirical formula $C_{10}H_{17}NO$, is extracted by chloroform from the cathode solution after the precipitation therefrom of the greater part of the sulphuric acid. It is described as a soft crystalline mass, having a faint camphor-like odor and a melting point of 220° C.

Camphidin, $C_{10}H_{19}N$, is strongly basic, as its formula would indicate, and is obtained from the acid filtrate from which camphidon has been separated, by rendering the same alkaline and distilling with steam. Camphidin is crystalline, having an intense odor of camphor, and a melting point of 186° C. The formation of one or the other of these compounds depends upon the duration of the reduction, and under the conditions stated both compounds are produced. Their uses are pharmacal.

ELECTRIC FURNACE.

A deparature from the usual type of electric tube furnace consists in providing within the tube an auxiliary heating means in the form of an arc between carbon terminals. The tube walls are composed of resistance material and are brought to incandescence by the passage of a current in the usual manner. A longitudinal section of the furnace is shown herewith. The tube is constructed of graphite sections, *b*, surrounded by an insulating sheath, *c*, and encased by sheet metal, *a*. This tube is mounted for rotation between stationary caps, *f*, *f'*, these caps being lined interiorly like the tube with insulating material and with graphite. The bearings consist of metal rings, *b*, mounted on the tube and turning on rollers, 5, power being applied to the tube through a pulley, 10. The furnace is preferably mounted at an inclination, and the feed and discharge occur through the cap plates. The terminals, 16, 16, of the heating circuit are on the cap plates, and contact is made through the annular graphite blocks, *g*, with the tube revolving in contact with them. The auxiliary heating circuit comprises carbon electrodes, *m*, *n*, introduced through the cap plates, and adjustable therein to form an arc at any desired portion of the furnace.

Electricity at the New York Military Tournament.

During the recent military tournament held in Madison Square Garden, the Electrical Corps of the Thirteenth Regiment, Heavy Artillery, N. G. N. Y., participated on two evenings, giving a torpedo defense drill. Company M of this regiment was designated by Col. Austen sometime ago to have charge of all electrical apparatus used in connection with the work of the regiment, such an organization being vitally necessary, as electricity enters so largely into the manipulation of heavy artillery in all coast defense operations. The corps have given several exhibitions in their armory in Brooklyn during the past winter, and their recent performance repeats their past successes. The drill at the Garden was devised to show torpedo harbor defense, and illustrated an attack on a supposed harbor by a hostile fleet at night. All was carried out in miniature, the tanbark arena representing the harbor.

As one of the spectacular features of the tournament, it was highly successful and from an instructive point of view very valuable, as it showed the public although on a small scale, how effectively a harbor can be defended by submarine mines. The system used is what is called "controlled automatic," and which can be operated manually from the shore as in judgment firing, or automatically by making proper switchboard arrangements. A vessel coming into contact with the mine closes the circuit through the charge, working as it were its own destruction. The wiring system used was much more extensive than in any of the previous efforts of the corps, and its complete success showed the thorough training of the young artillerymen. The open contacts in this instance were mounted on a short post placed directly over the mine, and which projected above the surface of the tanbark in the arena. The miniature ships were hauled across the tanbark surface and when over the buried mines closed the contacts, indicating on an annunciator located near the firing keyboard. The mines proper consisted of tightly wound bags of powder in which had been placed fuses, and were connected to the firing circuit through a resistance which, while letting sufficient current pass for testing purposes, was not strong enough to ignite the fuse. The firing was accomplished by cutting out this resistance, permitting the full force of the firing current to pass through the mine, causing the fuse to blow, exploding the mine and destroying the ship. The annunciator and firing keys were located in the cellar, and so far as the man operating them was concerned, might have been miles distant. Automatic firing was not tried, because, for reasons of safety, it was thought best to have the mines under

control. This system is used in actual warfare, and is especially useful at night, the automatic mine being unreliable at best.

Four searchlights traced the movements of the vessels across the darkened arena. A complete system of telephones was installed by which the commander was enabled to be at all times in instantaneous touch with all the points which effected the operations. Incandescent lamps were also used for signaling purposes.

The exhibitions in which this corps have engaged have been of the greatest value in giving the men who engaged in them experience in the handling of electricity, because they learn how necessary it is for them to be thoroughly trained in handling all the instrumental devices entering into their work. They learn that when anything goes wrong, "the other man" cannot be pleaded by the electrician—which teaches them that the utmost carefulness must be exercised in operation, or failure results. They learn that in addition to knowledge, courage is a great thing, as they must not know failure by any name whatever. As all the apparatus used in these drills is a miniature of what would be used in actual service, it is the best possible kind of instruction, as it is always preferable in technical training to give practical illustrations and experiments, rather than confine the course of instruction to reading and lecturing only. Sergeant M. C. Sullivan, who has been in charge of the instruction and drilling of the corps for the past year, was in command.

CURRENT NEWS AND NOTES.

VESTIBULE CARS.—Governor Odell has signed the bill which provides that street surface railroad cars operated throughout the State except in New York and Brooklyn, in the months of December, January, February and March, shall be equipped with vestibules. Companies operating in cities are given three years in which to complete the equipment of their cars.

RAPID TELEGRAPHY ABROAD.—A cable dispatch from Berlin of May 9 says: The government experiments between Berlin and Königsberg with the Pollak & Virag system of quick telegraphy show favorable results. A speed of 40,000 words an hour has been reached. The government will now adopt the system for practical purposes between Berlin and Frankfort-on-the-Main.

DISCHARGE OF TELEGRAPH OPERATORS.—At St. Louis on May 8 Commercial Telegraphers' Union of America filed a petition in the United States District Court asking Judge Adams to issue an injunction to restrain the Western Union Telegraph Company from discharging men belonging to the union. The petitioners also ask that the company be restricted from blacklisting members of the union and from interfering with them in any manner.

MONT BLANC RAILWAY.—It is stated that plans have been drawn up for an electric railway from Le Fayet, about twelve miles from Chamounix, to the summit of Mont Blanc. The first section to be connected is to include in its stations the Motivon, the Col de Voza, Mount Lachat, Les Rognes and Tete Rousse, the provisional terminus being l'Aiguilie du Gouter, at 12,500 ft. above the mean level of the sea. Later the line is to be prolonged to the summit, 15,780 ft. above the sea level. The Municipal Council of St. Gervais has approved the scheme and granted the concession.

NEW ENGLAND LIGHTING.—Negotiations are said to be under way for a consolidation of a number of the electric light and gas companies in New England cities. The deal is being financed by a syndicate of New York and Boston capitalists, and it is reported that options on the majority of the plants which will be included in the combination have already been secured. The taking over of the individual companies has been carried out by giving the stockholders shares in the combine equal to the value of the stock held in the individual companies. The promoters say that the consolidated companies will curtail the working expenses and enable the combination to decrease the cost to customers.

HEAT OF RADIUM.—In the *New York World* of May 10, M. Pierre Curie, speaking of radium, says: "The heating powers of radium are very great, but so far its industrial uses appear to be very limited, as at the present price even the richest of your American millionaires could hardly hope to have his house heated with the aid of this new discovery. Some use of radium has already been made in the practice of medicine, and Dr. Daulas, of the Hospital St. Louis, has used it in skin diseases and found it efficacious in the treatment of cases of lupus. The substance has the remarkable property of continuously emitting heat without combustion. Half a pound of radium salt will evolve in one hour heat equal to that produced by the burning of one-third of a cubic foot of hydrogen gas, and this evolution of heat continues for indefinite periods, leaving the salt at the end of months of activity just as potent as at the beginning. We have in radium a substance having the power to gather up and convert into heat some form of ambient energy with which we are not yet conversant.

ELECTRICIANS FOR THE ARMY.—The last Congress provided for 100 electrician sergeants at $408 per annum, and 25 master electricians at $75 a month and allowances. The War Department has issued a general order in regard to these appointments. Enlisted men desiring appointment as master electricians are to apply to the commandant of the school of submarine defense at Fort Totten, N. Y., through military channels. An applicant will not be recommended unless he has had a thorough course of study in electricity, mathematics, physics, etc., and three years of practical training in the use and care of steam and oil engines, of machines and machinists' tools and electrical appliances and apparatus. Applicants from civil life for appointment as master electricians will apply direct to the commandant of the school, and are required to give certificates from responsible persons of their qualifications, which must be of the same character as is required from the enlisted men. A practical examination of applicants who have passed a satisfactory theoretical examination will be held at the Fort Totten school for a period not to exceed two months, beginning August 1 next.

LETTERS TO THE EDITORS.

Parallel Operation of Direct-Connected Alternators.

To the Editors of Electrical World and Engineer:

SIRS:—The article of Mr. T. C. Oscanyan in your issue of April 18 points out the advantages in placing dampening devices upon the pole pieces of the fields of such alternators as give trouble in parallel running. I think that these advantages can more clearly be seen if we look at the case from another point of view.

The placing of damping devices upon the pole pieces of an alternator may be considered not a change in the alternator itself, but rather an addition of a powerful asynchronous motor to each unit, for the damping device is nothing else than the rotor winding of an asynchronous motor. The stators of these motors are the armatures of the alternators, and when the fictitious asynchronous motor runs at synchronous speed, it takes no wattless current from the mains as in the case of an ordinary asynchronous motor.

As soon, however, as there arises any difference in the angular velocities of both units, a current will flow from the faster running to the slower running unit, and the fictitious asynchronous motor will help the engine to bring the field of its generator up to synchronous speed. We can also consider the damping device as a magnetic clutch, working only through the effect of a flux upon short-circuited windings, in magnetically coupling both ends. But it is evident that such a clutch is the equivalent of an induction motor.

A good illustration of a properly devised damping device as applied to direct-connected alternators is found in experiments made some years ago in the electric lighting plant at St. Ouen, France. A report of these experiments was published in *Bulletin de la Société Internationale des Electriciens,* December, 1898, page 498, a short abstract of which was reprinted in the *Elektrotechnische Zeitschrift,* 1900, page 45. In this plant two alternating-current generators of 250 kw each, with damping devices upon their pole pieces, were direct-connected to cross-compound engines, running at 67 r.p.m. When the units were connected in parallel and giving current to the mains, the field circuit of one unit was opened and the steam shut off the engine of the other unit. This extraordinary proceeding

had no effect on the motion of either unit, both continuing to run.

To understand the function of both units it is merely necessary to point to the fact that the damping devices are equivalent to the rotor windings of an asynchronous motor, and it is well known that an asynchronous motor worked above synchronous speed throws electrical energy back into the mains and requires mechanical energy for driving, thus becoming an asynchronous generator. This was furnished by the steam engine to the alternator, the field of which was not excited. The other alternator was running as a synchronous motor with an angular velocity a little less than the other or asynchronous generator, and in turn drove its engine from which steam had been shut off.

If properly devised damping devices will produce such results, they will also keep the alternators in step. Of course, this work decreases their efficiency, as any difference in the angular velocities generates a current in the damping devices, which is a loss to the generator. But if alternators running in parallel do not have damping devices, their engines must have heavy fly-wheels to obtain a minimum difference of angular velocities. And a heavy fly-wheel gives a greater loss of energy by friction than a lighter one, so that probably in both cases the losses of energy will be equivalent. As to the commercial features, it is only necessary to point out that a damping device may involve not only expense for its production, but also royalties on patents, while on the other hand a heavy fly-wheel requires a larger shaft and bearing than a lighter one.

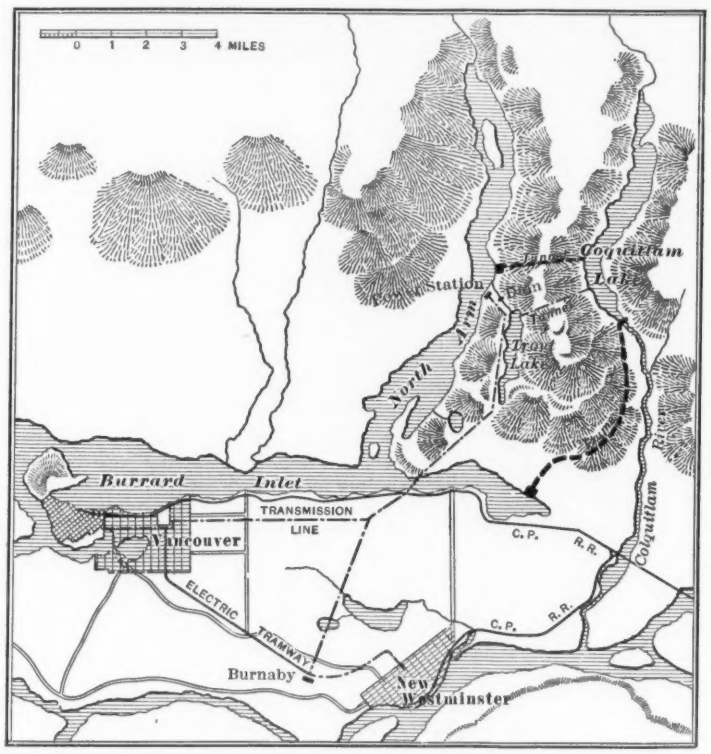
Mr. Oscanyan refers only to Corliss engines connected to alternators, but I do not think it necessary to confine the application to this type of engine, as other prime-movers give similar trouble when direct-connected to alternators if they have not sufficient weight of fly-wheel or damping devices on the pole pieces of the alternators.

PITTSFIELD, MASS. FRDR. W. KNOPFE.

The Vancouver Power Plant.

To the Editors of Electrical World and Engineer:

SIRS:—Fearing that your editorial under the title, "The Vancouver Power Plant," in your issue of April 18, might be misinterpreted, I beg to make the following explanation of the peculiar



MAP SHOWING ROUTE OF VANCOUVER TUNNEL.

conditions existing which made it advisable to adopt the extraordinary methods in the hydraulic development.

Trout Lake as a source of power is in itself of no value whatever, as the watershed is very limited and the outlet is practically dry, except during the rainy season. The original scheme was to develop the Coquitlam by fluming along the steep hillside a distance of about seven miles, and placing the power house at a point on Burrard Inlet, approximately as shown by the dotted line on the accompanying map. The soil along the proposed flume route is of a peculiar nature and exceptionally subject to landslides, which would make expensive construction, and the flume would also be subject to serious interruptions which would cripple the service for long periods, no matter what precautions were taken. This scheme was discarded on account of there being no storage at the end of the flume, the heavy cost of depreciation and maintenance and the unreliability of service.

It was then suggested that a tunnel connecting Coquitlam Lake with a point on the north arm, as shown by the dotted lines on accompanying map, be installed. The main objections to this scheme were that there was no feasible means of procuring storage to act as a balancing reservoir, and also that the tunnel would of necessity be large enough to carry the highest peak load. The writer, after looking over the ground, suggested that the tunnel connect Coquitlam and Trout Lakes. By this method Trout Lake acts as a balancing reservoir and the tunnel required is only large enough for the average, instead of the peak load. When the depreciation and maintenance on the proposed flume in the original scheme was taken into consideration, it is readily seen that this amount would pay the total cost of the tunnel in approximately fifteen years. The depreciation and maintenance on the hydraulic system being iustalled at present will be exceedingly low, and this fact in connection with the reliability of service to be obtained, and the freedom from high water and freshets, will make an ideal installation.

SEATTLE, WASH. K. G. DUNN.

Fuel Consumption in Central Stations.

To the Editors of Electrical World and Engineer:

SIRS:—Noting in your issue of the 18th inst. a letter relating to the above subject, in which it is claimed, "The pounds of water evaporated per kilowatt-hour, including only the energy transformations in pipe line, engines, generators and cables, gives no indication, unless the pounds of water evaporated per pound of coal is stated, of the boiler room operation where the largest losses always occur"; and the opinion further expressed that the economy of power station operation if expressed in pounds of water used per kilowatt-hour is of doubtful value, and that the "real need is of a simple expression for the economy of the station as a whole," I beg to differ from the writer of said letter for the following reasons:

First. The largest losses do not always occur in the boiler room, as the varying efficiencies of boilers under the usual range of conditions do not differ as widely as the varying efficiencies of engines, due to difference in character of loads, types of engines, etc. Boilers usually give their best efficiency when operating at or above their rated capacity, with an average efficiency when operating at one-quarter or one-half loads, ranging generally from 60 to 75 per cent. of their maximum efficiency; while engines operating on widely varying loads (as frequently required, particularly for railway service) show efficiencies varying much more than the boiler efficiencies mentioned.

Second. While primarily a simple expression for the economy of the station as a whole is desirable, yet when it shows results not up to usual standards, there can be no intelligent analysis of the conditions made or remedy prescribed, without sufficient data for separating the operation of the boiler room from that of the engine room, the relative efficiencies of the two not being fixed since each can be varied without affecting the other.

As illustrating the above, a railway power plant furnishing current (without storage battery auxiliaries) for operating the average electric railway of 20 to 40 miles in length, giving hourly service, will be required to take care of loads varying from friction load to 25 or 50 per cent. loads beyond the rated capacity of the machinery (if the units are suited in size to their average duty, as is usually aimed at where best economy is desired). Notwithstanding, however, even these great variations in load, the boiler efficiency of the plant varies but slightly from what it would be with a steady load equal to the average of the fluctuating one; the average engine efficiency, however, is very much lower with the fluctuating load than it would be with the steady one. If, however, under either of these conditions more boiler capacity is used than can be worked on the average up to its rated capacity, the boiler room efficiency will be reduced without changing in any way the engine room efficiency.

Per contra, if storage battery auxiliaries are used, the load on the power house kept constant, and the units are of the proper size

to operate the average load economically, then the engine room efficiency will be greatly improved over the first condition mentioned, while the boiler room efficiency (if boilers are worked up to their rated capacity), remains practically the same, but less boiler capacity is, in the last-mentioned case, required.

There being, therefore, no fixed relation between boiler room and engine room efficiencies, the pounds of water evaporated (preferably expressed from and at 212°), must be known, to separate the records of operation of the boiler and engine rooms and analyze properly the station performance as a whole.

My suggestion not having been to omit the pounds of coal (or pounds of combustible) from the station records, but to add to them and the kilowatt-hour output "the pounds of water evaporated" (preferably from and at 212°), I again urge the securing of data as to the evaporation, that any general power station results not found up to the standard of best practice, may be intelligently analyzed and a proper remedy prescribed for the purpose of improving the economy of operation and likewise the net profits resulting therefrom.

Detroit, Mich. Joseph E. Lockwood.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Shell and Core Type of Transformers.—Niethammer and Eborall.—Some controversial communications on the subject of transformer design. Eborall had stated that it is impossible to build shell-type transformers of 100 kw with a maximum voltage drop (induction load) of less than 4 per cent., without getting a bad efficiency. Niethammer points out that this is an error, as nearly all American concerns and their affiliated European companies design all their large transformers as shell-type and with excellent results. The Union Electric Company, of Berlin, has built a great many shell-type transformers from 75 kw up to about 2,000 kw, with regulations of 1½ to 3 per cent. (maximum induction drop, short-circuit load) and has, at the same time, obtained efficiencies of 97.5 to 98.3 per cent.; the iron losses are usually slightly larger than the copper losses at full load. By using a good system of ducts and artificial cooling, the disadvantage of excessive heating of the shell-type is entirely overcome. Eborall replies that his views are supported by theory and by practice, and that it can only be a question of time before the shell-type of transformer will be abolished for everything but purely lighting work. Its only advantage is that it is cheap, while its disadvantages are that it is unmechanical, difficult to insulate, difficult to keep cool, and difficult to design for high efficiency over a wide range of load and good regulation at the same time. The two large American companies still adhere largely to the shell type. "This predeliction of the American for an out-of-date type is difficult to explain, but it may be due to the fact that American experience with transformers used on highly inductive loads is certainly much less than that in Continental Europe, by reason of the much larger extent to which rotaries are used over there. Whereas the Continental engineer makes a point of using three-phase current directly, when anyhow possible, the American prefers apparently to put a rotary in between, which, at any rate, has one advantage—it gives him a load of a high power factor. Thus the need of transformers which shall have full load drops of a few per cent. on a power factor as low as 0.5, does not arise, and thus the shell type is in this respect good enough. The American engineer simply employs three of his standard lighting transformers suitably connected." In recent years the General Electric Company have got out a complete series of standard core transformers which they specially recommend for power work.—Lond. *Elec.*, April 24.

REFERENCE.

End Play Device for Machines.—See the abstract "London" under Traction.

Lights and Lighting.

REFERENCE.

Electric Lighting of Railroad Cars.—Goetze.—Continuation of his serial on this system.—*Centralblatt f. Accum.*, April 1, 15.

Power.

Independent Crane Conveyors.—E. K. Scott.—An article on the use of independent crane conveyors for the coal supply in central stations. In small stations where it would not pay to lay down an elaborate conveyor plant, he thinks there is a future for the small independent crane conveyor which runs on overhead steel girders or rails and is actuated by an operator who rides with it. Consequently it may be taken in and out, round curves of comparatively small radius, and into out-of-the-way corners which cannot be served by the ordinary continuous conveyors, because the latter must always work in a straight line. The independent conveyor consists of a small locomotive and crane combined, the motor of which is supplied with current from the girder rails on which it runs, or else from a pair of trolley wires fixed between the upper and lower flanges of the rolled steel joist, on the lower flanges of which it is supported. It may be used to carry other things besides coal.—Lond. *Elec. Rev.*, April 24.

REFERENCE.

Swiss Plant.—Rung.—A well-illustrated description of the hydro-electric power installation at Bezman, Switzerland, supplying current for lighting the nuemerous towns in the neighborhood and also for the supply of power for electrically driving several large workshops, silk-spinning mills, and a few small electrical railways.—*The Eng.*, May 1.

Traction.

Three-Wire System for Traction.—An illustrated description of the Grenoble-Chapareillan tramway, which is 43 km long, and on which the three-wire system is used with 1,200 volts between the outers. On the whole length of line overhead copper wires of 9 mm diameter distribute current to the cars; the wires are situated 70 cm from each other. The generating station is situated at Lancey, water power being utilized; the price of current is 100 francs (20 dollars) per horse-power-year. There are two 600-volt, 417-amp. dynamos in regular operation in series connected to the bus-bars, as shown in

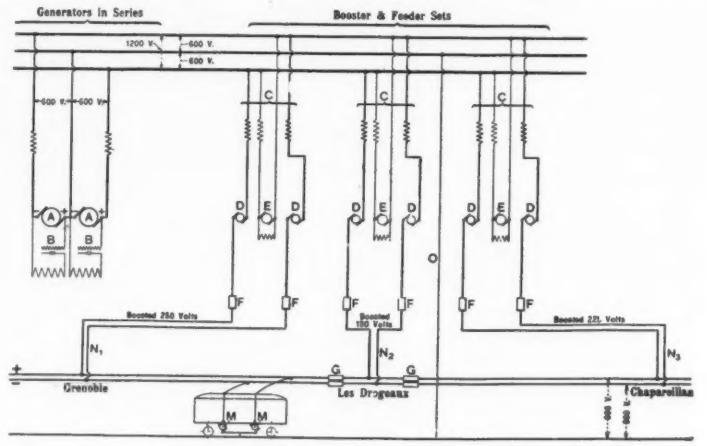


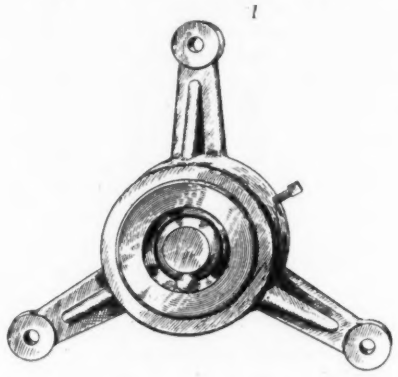
DIAGRAM OF GENERAL CONNECTIONS.

the adjoining diagram, the neutral wire being taken from the bus-bars connected to the common terminal of the two dynamos. The machines are compound-wound for 600 volts from no load to full load; they are shunt-excited and their field circuits include an automatic rheostat actuated by an automatic regulator on the Thury system. The neutral bus-bar feeds directly the neutral conductor of the tramway line, which is formed by the bonded track rails. The overhead wires are fed from the outside bus-bars of the station by means of boosters; these booster sets are each composed of two

series generators run by one compound-wound motor, as shown on the diagram on the right-hand side. The motor, *E*, is fed from the bus-bars and the generators, D, are series-excited and connected in series with the positive and negative poles. The boosters are protected against possible short-circuit by overload circuit-breakers. As there is also danger of the whole set being reversed and the booster generators being run as motors, each set is provided with an automatic apparatus which simply short-circuits the armature of the motor in case the shaft revolves in the reverse direction. In the adjoining diagram *A* are the compound-wound generators, *B* automatic field rheostats, *C* booster sets, *D* series boosters, *E* compound-wound booster motors, *F* overload circuit-breakers, *G* section insulators, *M* railway motors, N_1 feeder No. 1, boosting voltage 250 volts, N_2 feeder No. 2 boosting voltage 150 volts, N_3 feeder No. 3, boosting voltage 225 volts; 0 is a neutral feeder to the rails.—Lond. *Elec.*, April 24.

Italian Third-Rail Road.—An illustrated description of the Milan, Varese, Porto Ceresio electric railway which has a length of 47 miles. It was installed by the French Thomson-Houston Company, the third-rail system being used. The power house contains three steam-driven 750-kw, 13,000-volt, three-phase generators. There are five sub-stations along the line, on the average about 10 miles apart; the three which are nearer Milan are equipped with two compound-wound, 500-kw synchronous converters each, the other two having one 250-kw converter each. In each of the larger sub-stations there are seven air-blast cooled transformers of 180 kw each, one being held in reserve; these reduce the pressure to 420 volts, from which the converters give direct current at 650 volts. The other two sub-stations are provided each with a buffer battery of 323 cells, of 320 amp-hours' capacity when discharged in one hour, and with a Thury motor booster. The Thury automatic regulator is used to maintain the output of the converter constant at all times, the battery and booster being connected in parallel with the converter. A battery of 505 amp-hours' capacity is also installed in the sub-station nearest to Milan.—Lond. *Elec. Rev.*, April 24.

London.—An illustrated description of the Hampton Court line of the London United Tramways Company. Three-phase current at 5,000 volts is used for transmission to a sub-station in which by means of transformers and synchronous converters the alternating current is changed to direct current of 500 volts. A special feature of the converters is the end play device shown in the adjoining figure;



END-PLAY DEVICE.

its object is to oscillate the armature so as to cause an even wearing of the bearings, commutator and collector. The ball race is kept pressed forward by means of a fairly stiff spiral spring and the device is screwed to the pillow-block by means of the three arms, so that the ball touches the end of the shaft when the shaft is about 1/32 of an inch from the end of its thrust. The armature is thus balanced laterally against a spring and is kept in a state of more or less constant axial oscillation.—Lond. *Elec.*, April 24.

Surface Contact System.—SHAWFIELD.—A reprint of his official report to the Wolverhampton corporation on the results obtained during one year, with the Lorain surface contact system on a trial line in that city. The report is in form of a comparison between this and the trolley system. Concerning safety to men and animals he concludes that although with the Lorain system there is probably a somewhat greater liability to harmless shocks, there is distinctly less risk of serious injury to users of the streets than with the overhead trolley system. On the score of reliability he thinks there is very little to choose between the Lorain system and the trolley system. The consumption of electrical energy per car mile is greater with the Lorain than with the trolley system; the total average current consumption per car mile with the Lorain system under normal conditions of traffic, is about 1.4 units per car mile, while it is 1.15 for the trolley system; in other words, 22 per cent. more energy is consumed, which represents about 0.82 cent extra cost per car mile. The cost of maintenance is also greater with the Lorain system than with the trolley, the difference being estimated is 1.626 cent per car mile. Some very brief notes are added on other surface contact systems, namely those of Dolter, Kingsland, Johnson, Lundell, Schuckert and Diatto.—Lond. *Elec.*, April 24.

Seattle-Tacoma.—A description of this interurban railway which is 36 miles long, the third rail being used in general and the trolley in the cities and where the road runs on the highway; the cars pass over crossings by their momentum. Power is distributed from three sub-stations to which it is transmitted from the main stations at each end of the line at 25,000 volts, generated at 2,200 volts and 60 cycles. The power station in Seattle is also used for lighting purposes. Induction motors directly connected to direct-current generators are used instead of rotary converters in the sub-stations and are in units of 300 kw each. The transmission wires are spaced on a 40-in. equilateral triangle and could be operated at 60,000 volts if desired. The cars are run in trains of 2 or 3 cars each; each car is equipped with 4 motors of 125 hp each and is fitted with multiple-unit control. The company also has an electric locomotive fitted with the same equipment, but with lower gear ratio.—*St. R'y Jour.*, May 2.

Electric Traction on Swedish State Railways.—A note stating that the exploitation of the many large waterfalls in Sweden has of late years gone ahead at a great pace, and that the Board of State Railways has recently presented a report to the government in favor of operating the railways by electricity.—Lond. *Eng'ing*, April 24.

Wattmeters on European Cars.—An article on the control of motormen by means of wattmeters. This is done in Magdeburg and the relative efficiency of the different men is reduced to a standard basis of comparison, viz., the ton-kilometer. Inefficient men are discharged and prizes are given to good men. The saving effected in energy after deducting the cost of operation and repair of the wattmeters and prizes to the motormen, varies between $1,800 and $2,000 per quarter of a year. The Rheims Tramway Company has also adopted a somewhat similar practice.—*St. R'y Jour.*, May 2.

REFERENCES.

Three-Phase Traction.—The first part of a well-illustrated description of the Valtellina Railway on which, as repeatedly noticed in the Digest, three-phase currents are transmitted at 20,000 volts, the voltage being reduced to 3,000 in transformers placed along the line, 3,000-volt, three-phase induction motors being used on the cars. —Lond. *Elec.*, April 24. The first part of an illustrated description of the same railway, by Cserhati, is in the *Elek. Zeit.*, April 27.

Multiple-Unit Systems in London.—The first part of an illustrated article on the electrically-equipped trains for the Metropolitan District Railway in London. This company has placed an order for the electric equipment of two seven-coach trains with the British Westinghouse and the Thomson-Houston companies respectively. The main object is to compare the Westinghouse and Thomson-Houston systems of train-control, and it will also afford an opportunity for teaching the drivers how the multiple-unit system, which is practically new in England, is manipulated. The equipment of the trains is described and illustrated.—Lond. *Elec.*, April 24.

Conduit Construction in Brussels.—A description of the original method of conduit construction planned for the Brussels tramways and of the method now actually used, which is much cheaper.—*St. R'y Jour.*, May 2.

Roadbed.—SATTLER.—The first part of an article on roadbed construction for tramways.—*Elek. Anz.*, April 26.

Friction Between Wood and Iron.—KLEIN.—An article on the friction coefficient between wood and iron and its influence on braking.—*Glueckauf*, April 25.

Automobile Exposition.—Two articles giving some notes on the recent automobile exhibition in Agricultural Hall in London and on the German Automobile Exhibition in Berlin.—*Centralblatt f. Accum.*, April 15.

WIRES, WIRING AND CONDUITS.

Fuses.—An article on the development of the construction of safety fuses in recent years. Aluminum is regarded by some engineers as a very good fuse for currents from about 20 to 100 amp.; in important installations aluminum and platinoid have been used very successfully for such current for several years past, and pure tin wire from 3 to 20 amp., but the opinion is expressed that the former metal could be used equally well for every case exceeding 3 amp. Of course the increased expense is a factor to be considered; still greater efficiency and less risk of arcing are worth something. It is thought that copper is not as safe a metal to use for heavy work as aluminum; and on no account should it be adopted for light work. Some notes are given on enclosed fuses.—Lond. *Review*, April 24.

REFERENCES.

Calculation of Networks.—An article on a simple method for calculating networks of conductors. Most of the methods, now in use, require the solution of as many linear equations as the network has branching points; this takes time and gives one no good idea of the system. His method avoids this practical disadvantage and is relatively easy to use, but cannot be described briefly. The article is illustrated by a long series of diagrams which explain the formulas.—*Elek. Zeit.*, April 23.

Elementary Treatment of Conducting Networks.—WILBERFORCE.—A brief note in which the author shows that the well-known reciprocal relations between the parts of a conducting network can be readily established without an appeal to the properties of determinants.—*Phil. Mag.*, April.

ELECTRO-PHYSICS AND MAGNETISM.

Radioactivity of Uranium.—RUTHERFORD AND SODDY.—A paper in which they discuss the radioactivity of uranium, as compared with thorium. The case of uranium presents some interesting features and is in some respects simpler than that of thorium. They make an important distinction between the photographic and electric effects. The uranium radiation consists of two types: First, the easily absorbed rays, second the penetrating rays which are readily deviable in a magnetic field. The former constitute by far the greater part of the electric effect, the latter practically all the photographic effect. The case of uranium is especially interesting on account of two points: First, the existence of non-separable activity consisting entirely of easily absorbed rays, as in the case of thorium; second, the non-existence of easily absorbed rays in the radiation of "uranium X." This is probably an example of a general law that when gotten by itself free from the matter which produced it, on the one hand, and the products of its further change on the other, each type gives rise to homogeneous rays, and that in all cases the easily-absorbed rays are produced first and the magnetically deviable and penetrating rays only result in the final stages of the disintegration. Uranium gives more definite evidence on this point than thorium.—*Phil. Mag.*, April.

REFERENCE.

Iron Powder.—MAURIAN.—An article illustrated by diagrams, in which he gives the results of an experimental investigation of the magnetic properties of iron powders.—*L'Eclairage Elec.*, March 28.

ELECTRO-CHEMISTRY AND BATTERIES.

Treating Nickeliferous Copper Matte.—VON KUEGELGEN.—An article in which after some brief remarks on the process of Ulke (Transactions Am. Electrochem. Soc., Vol. I, p. 95), he describes a similar process, worked out by Guenther in Borcher's laboratory. The process is similar except that Ulke uses an ammoniacal nickel solution with insoluble (lead) anodes, while Guenther uses an acid solution and soluble anodes. He thinks that the last traces of copper can be most easily removed by means of precipitation by hydrogen sulphide; for the separation of the iron from nickel, he recommends separation of the nickel in form of nickel ammonium sulphate, which crystallizes out when the solution is cooled, while the iron remains in solution. If the iron and nickel are present in a proportion of 1 to 15, this separation is nearly quantitative; if this proportion is 1 to 2, about 90 per cent. of the nickel is separated. Concerning the electrolytic treatment of the nickel salt for the production of metallic nickel, he first tried insoluble (lead) anodes and various electrolytes, but found that there were disadvantages, one being the low solubility of nickel ammonium sulphate, the other the relatively high voltage required; some of these are prevented by using soluble anodes. Moreover, it is desirable to use for the electrolyte a nickel salt like the sulphate, which is more soluble than nickel ammonium sulphate, and has a smaller tendency to crystallizing out with decreasing temperature. The principle of his process is to utilize the anodic energy of the current by using at the anode as electrolyte a mixture of two salts, the one electrochemically attacking the metallic anode, while the other decomposes the soluble metallic compound thus formed, the result being the regeneration of the solvent and the formation of an insoluble salt useful as a coloring material. This idea led to the necessity of a diaphragm, the cathodic part of the coil containing the nickel sulphate, and the anodic part the mixture above mentioned. In all cases he obtained good nickel at a moderate voltage and satisfactory ampere-hour efficiency, but in every case the anodic by-product was for some reason unsatisfactory, and he therefore concluded that his original idea was not practical, and had to be modified; he now uses in the anodic part of the cell only the salt which dissolves the anode, but the precipitation of the insoluble salt is made outside of the cell. In the electrolysis the voltage varied between 3.5 and 4 volts at a current density of 400 to 500 amp. per square meter and at a temperature of 60 to 65° C. The ampere-hour efficiency of the nickel production was above 90 per cent., when no higher current density than 400 amp. per square meter was used. The nickel produced was good.—*Zeit. f. Elektrochemie*, March 19.

Production of Metallic Potassium from Molten Potassium Hydroxide.—LORENZ AND CLARK.—An article in which they refer to the fact that the production of metallic potassium from its molten hydroxide meets with difficulties, while the electrolytic production of metallic sodium from molten sodium hydroxide is very simple. They refer to the theory of Lorenz on the electrolysis of molten salts which had been found to be correct by a great many experiments. According to it, the metals deposited at the cathode have a tendency to form what he calls metallic mist or fog, which is dependent upon the vaporization of the metals at the temperature of the bath; it acts like a depolarizer, reducing the ampere-hour efficiency. From this theory the tendency for the deposited metal to redissolve and form a metallic mist is much greater for potassium than for sodium; it is, therefore, necessary for the production of metallic potassium from its molten hydroxide that the cathode be enclosed by a porous diaphragm which serves to hold the potassium mist together. Experiments have fully confirmed this; as cathode he used an iron wire 3 mm thick passed through the top of a magnesite globe, the bottom of which is open; this globe is placed in the molten salt and acts as a porous cup; after the electrolysis it was found to be filled with solid potassium. They thus electrolyzed molten barium hydroxide in order to get barium; but barium oxide, and not barium, was found in the globe; the authors assume that the deposited barium reacts at once with the barium hydroxide. Magnesite was found to be an excellent material for such diaphragms, but it is not suitable for the electrolysis of molten chlorides.—*Zeit. f. Elektrochemie*, April 2.

Galvanic Cells.—MUGDAM.—Continuation and conclusion of his article. The galvanic cell combined with a motor is theoretically the most perfect machine for converting chemical into mechanical energy, but this is not true in practice, and in spite of its bad efficiency, the steam engine is the cheapest method. The two disadvantages of galvanic cells are that the limited number of chemical reactions which can be utilized in them are all expensive, and that there are also losses, although they are smaller than in engines. He discusses briefly the galvanic cells used in practice and makes some remarks on the use of aluminum for electrodes, after which he takes up carbon cells; theoretical remarks are made on these among others that Nernst's calculations show that the combination of carbon and oxygen forming carbonic acid gas, gives as the e.m.f. of the ideal carbon cell about 1 volt. The experiments made to construct a practical carbon consuming cell are then noticed; and are thought to be very insignificant, as it has been proved that the energy given out was really due to the oxidation of carbon. He then refers to some roundabout ways of solving this problem and mentions as an instance the Daniell cell, the zinc sulphate of which may be regenerated by carbon, and the copper may be changed to copper sulphate, so that the cell may be used in a cyclic process, in which it gives out energy consuming only carbon and oxygen; but this very uneconomical and complicated device can scarcely be considered as a carbon cell. In summing up he states that a cell in which the oxidation of carbon renders work, is quite possible, but the technical

difficulties are enormous, the cost of installing and maintaining being especially great.—*Chem. Zeit.*, April 1, 15.

Carbon Electrodes.—A summary of notes on the manufacture of carbon electrodes. Acheson's method is illustrated and described; the following notes on the method used in the German plant of Lessing are given. The special feature is the necessity of using very large machines, and pressures of 340 kg per sq. cm. The starting material is the retort carbon of gas works; pieces reduced to hand size and are heated to 1,200° C, not in contact with air. After reduction to an extremely fine powder it is mixed with absolutely dry tar, formed, pressed and then left in the air to harden. They are then heated in furnaces to 1,300°, which is the most difficult operation, and it is recommended to spend about two weeks for this heating and cooling. The French company, Le Carbone, uses the Girard & Street process of making graphitized electrodes; their furnace is designed for continuous operation; the carbon blocks pass through it from the top to the bottom and are heated up to white heat by several arcs; a furnace consumes 10,000 amp. at 130 volts; the principle of the process is that each carbon in the arc zone serves as electrode for one or several arcs.—*Zeit. f. Elektrochemie*, March 26.

Electrolytic Dissolution of Platinum by Means of Alternating Currents.—RUER.—An account of experiments on the dissolving of platinum in various electrolytes under the separate or combined influence of alternating and direct currents. In one arm of a U-shaped tube there were the two platinum electrodes of the sinusoidal alternating current; the other arm contained the cathode of the direct-current circuit, one of the two other electrodes in the other arm being the anode of this direct current. In a sulphuric acid solution containing two parts of acid to one part of water, he found that platinum is not dissolved by the alternating current alone, as long as there is no oxydizing agent in the solution; but it is dissolved by the combined action of alternating and direct current; also by the alternating current alone when an oxydizing agent like chromic acid or even oxygen is used. Most of the other electrolytes which he tried behaved in the same way, but in some, like hydrochloric acid, sodium chloride, etc., in which one ion has a tendency to form a complex ion with platinum, alternating current alone dissolves platinum without oxydizing agents; but in these the platinum is dissolved under certain conditions by direct current alone. He assumes that the attack on the surface by alternating current is due to a formation of a very thin oxide layer when the platinum is anode, and to the reduction to a lower soluble oxide when the platinum is cathode. Passive iron behaves in a way similar to platinum, from which he concludes by analogy that the hypothesis that the passivity of iron is due to an oxide layer, is not impossible.—*Zeit. f. Elektrochemie*, March 19.

Bipolar Electrodes.—BROCHET AND BARILLET.—An article on the use of a metallic plate placed without any electrical connections, between the anode and cathode in an electrolyte, but not filling out the total cross-section. Copper sulphate was used as electrolyte in all the experiments; at first they used platinum as the anode and as the intermediate plate; then they used a platinum plate coated with copper on the side toward the cathode for the intermediate plate; finally, they used a copper anode. The observations made in these different cases are described in detail, especially those under the conditions in which the intermediate plate acted as a bipolar electrode, or as an inert plate; and the results are what might be expected from theory.—*Zeit. f. Elektrochemie*, March 26.

Dannell.—An article on the same subject describing quite a number of experiments, and commenting on the experiments of Brochet and Barillet. Among those of his experiments in which he used copper plates as electrodes and copper sulphate as electrolyte, he made a porous intermediate diaphragm 7 cm thick of 1-cm arc lamp carbons, running horizontally.—*Zeit. f. Elektrochemie*, March 26.

Decomposition Curves of Copper Salt Solutions.—ABEL.—In a recent paper Miss Heiberg gave some decomposition curves of various copper solutions, which showed two sharp bends, one corresponding to the cupric ion discharge, the second, which was 0.1 volt lower, being assumed by her to correspond to the discharge of cuprous ions to metallic copper. The present author suggests that it is more probable that this second bend corresponds to the partial discharge of cupric ions to cuprous ions.—*Zeit. f. Elektrochemie*, April 2.

Cathodic Deposition of Lead.—ELBS AND RIXON.—In the electrolysis of lead salts the lead is deposited on the cathode in two different forms, either as bright thin leaves or as a sponge of needles with a dull lustre. The authors in the present note state that they have found that an electrolyte which deposits lead in the first form invariably begins to deposit spongy lead at the moment when it contains four valent lead ions.—*Zeit. f. Elektrochemie*, April 2.

REFERENCE.

Acetylene.—KEPPELER.—The first part of an article on the impurities of technical acetylene and on its purification.—*Zeit. f. Calciumcarbid Fabr.*, April 9.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Stereoscope for Röntgen Ray Photographs.—An illustrated article in which attention is called to the fact that stereoscopic Röntgen ray photographs, produced by using two focus tubes, or by using a single tube in two successive positions, are always too large for use in the ordinary hand stereoscope. A direct-vision spectroscope devised by Walter is described which is capable of viewing photographs of any size, consisting of a combination of a wide-angle photographic camera and two simple eye pieces; for these latter lenses of the ordinary hand stereoscope may be used. In Walter's spectroscope there are neither reflectors nor prisms, but only lenses. The construction is described and illustrated in detail.—*Elec. Rev.*, April 24.

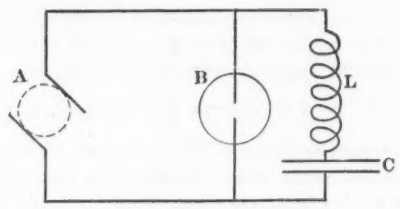
Units.—DOMPIERI.—An article in which he suggests a change of the absolute system of units. He purposes to divide the hour (which is as before the 24th part of a day) into 100 minutes, each of 100 seconds, and in the same way a circle into 24 degrees, each of 100 minutes, each of 100 seconds. The new second he suggests to adopt as the unit of time in electrical engineering. Instead of the centimeter-gramme-second system, he proposes to adopt the two-dimensional centimeter-second system, the mass having the dimensions, l^3t^{-2}. He urges that all electrical engineers should vote on the adoption of uniform practical units.—*Zeit. f. Elek.*, March 8.

REFERENCE.

Cable Testing.—DALTON.—The first part of an article, illustrated by diagrams, giving some notes on cable testing.—Lond. *Elec. Eng.*, April 24.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy.—SIMON AND REICH.—An article in which they first sketch the three epochs of the development of wireless telegraphy, the first characterized by the connection of the Righi oscillator with a vertical wire, as was done by Marconi; the second by Braun's transmitter of large energy capacity, small damping and large radiation; the third by Marconi's introduction into practice of Rutherford's magnetic detector. The author believes that much better results, both in respect to the distance of transmission and in the capability of tuning, could be obtained if the principle of resonance were fully utilized. All transmitters which are now used in practice are unsuitable for producing a sharp resonance phenomenon, because they all send out a series of rapidly damped waves interrupted by relatively very long intervals. What is wanted in order



WIRELESS TELEGRAPHY.

to accomplish an essential progress in wireless telegraphy, is the possibility of producing undamped waves, i. e., very high-frequency, alternating currents. The authors have not yet solved this problem, but believe they are approaching its solution; they make use of the Duddell phenomenon of the singing arc, in which a direct current is supplied to an arc lamp, which is in parallel with an inductance and a capacity; under proper conditions, alternating currents are produced. The authors use instead of the arc lamp a vacuum spark-gap, especially in the form of a Hewitt mercury lamp; this is shown in the adjoining diagram, in which *A* is a direct-current machine, *B* the mercury vapor lamp, *L* an inductance, and *C* a capacity; the frequency of the oscillations produced is then two times the square root of the product of *L* and *C*. The authors have repeated Hewitt's

experiments in which he uses high-tension, alternating-current, instead of direct current; they found that during one alternation of the alternator the lamp is lighted quite a number of times, there being relatively long intervals during which the lamp is not lighted. They believe that the use of the Hewitt lamp has certain advantages; by properly adjusting the system and by increasing the voltage, the intervals in which the lamp is not lighted, can be so diminished that one series of waves practically follows another. High-tension, direct-current is preferable to alternating current.—*Phys. Zeit.*, April 1.

Wireless Telegraphy.—Righi and Dessau.—A communication referring to questions of priority in wireless telegraphy. They state that "nobody prior to Marconi had utilized the antenna at the same time both in the generating and the receiving apparatus." An anonymous writer states that Lodge as early as 1889 used the vertical wire, whether called "antenna" or "aerial" does not matter; he also used horizontal antenna. The instruments used by Marconi at the beginning of his experiments were not substantially new; "they were, as all the world knows, in reality the inventions of Prof. Righi."—Lond. *Elec.*, April 24.

REFERENCE.

Block Signals.—Kohlfuerst.—An illustrated article on automatic electric block signals on the industrial railways from Barnstein to Muttershausen in Lorraine.—*Zeit. f. Elek.*, April 26.

MISCELLANEOUS.

REFERENCE.

Physiological Effects of Alternating Current.—Andriessen.—An article, illustrated by diagrams, on charging phenomena, using alternating currents, and the influence of high frequency on the dangers from shocks. He concludes a human body cannot stand a stronger current when alternating, whether of low or high frequency, than when direct.—*Elek. Anz.*, April 2, 5.

Electric Photography.

The subjoined cablegram from London of May 12 may refer to something very old or very new: John H. Heaton, M. P., who has returned from Italy, whither he accompanied Signor Marconi, says he saw at an observatory near Rome specimens of a new system of electric photography, by which clear pictures can be obtained of persons and scenes twenty miles distant. He thinks it conceivable that the system can be developed so as to enable the making of photographs of friends in distant lands while conversing with them by wireless telegraphy.

New Books.

Alternating-Current Calculating Device. For the use of Electrical Engineers. By F. G. Baum. Second Edition. Stanford University, Cal.: The Author. Price, $1.00.

Prof. Baum has issued a new edition of the pamphlet accompanying his device for calculating the regulation of a generator, transformer, transmission line or any combination of these for any load and any power factor. The device is also adapted to making synchronous motor calculations. In the latest form of the device some improvements have been added which extend its range. The text-book of instructions has been extended five pages, and the cuts on the back of the calculating device have been much improved by re-engraving. Prof. Baum's method of solving alternating-current problems is extremely convenient, it being possible to solve practical problems, not only in much less time than by the usual mathematical or the ordinary graphical processes, but with the liability of error very much reduced. Some of the more difficult problems usually considered beyond the capabilities of the average practical man, may, by its means, be solved as easily as the more simple ones.

Specielle Elektrochemie. Handbuch der Electrochemie. By Dr. H. Danneel. Halle: Wilhelm Knapp. 80 pages. Price, 3 marks.

Wilhelm Knapp, of Halle, Germany, the well known and enterprising publisher on the subject of Electrochemistry, begins with this volume the issue of a large and comprehensive handbook of electrochemistry. The following is a list of the subjects which will be included: Theoretical Electrochemistry, by Prof. Dr. W. Nernst, Göttingen; Measurements, by Dr. E. Bose, Göttingen; Special Electrochemistry, by Dr. H. Danneel, Aachen; Elements and Accumulators, by Prof. Dr. K. Elbs, Giessen; Electroanalysis, by Prof. Dr. F. W. Küster, Klausthal; Electromagnetic Ore Dressing, by F. Langguth, Mechernich; Technical Inorganic Electrochemistry, by Prof. Dr. W. Borchers, Aachen; Technical Organic Electrochemistry, by Prof. Dr. K. Elbs, Giessen; Electroplating, by Dr. H. Stockmeyer, Nürnberg. The publication of the series is estimated to take about two years. These handbooks are intended to give as wide an information as possible about every electrochemical reaction, known up to the present time, its origin, its theory and application. The idea is certainly a very good one and will be welcomed by all, who are interested in electrochemistry. As the prospectus says, there is no need to justify the issue of such a handbook. Every one who has done original work in the field of electrochemistry, and has been forced to spend many weary hours in hunting up the widely-scattered literature, will agree with the reviewer, that there is not only a want in the ordinary sense of the term, but a most crying need for such a book, in order to save much time and labor.

The present volume is the first section of the part dealing with "Special Electrochemistry," which will be complete in about 14 of these sections. The idea is to give in this part a compilation of the inorganic chemical reactions known up to now, with their literature, comprising data and literature on conductivity, polarization and changes of free energy in reactions (electromotive forces and single potentials). This first section deals among others with hydrogen, water, hydrochloric acid, sulphuric and persulphuric acid, etc., giving in detail their production and electrolysis in its historical development. The treatment is especially commendable for the large and valuable number of journals and patent references given.

BOOKS RECEIVED.

Reflexions sur la Puissance Motrice du Feu et Sur les Machines propres a developper cette Puissance. By Sadi Carnot. Paris: A. Hermann. 116 pages.

Induktionsmotoren. Ein Kompendium fur Studirende und Ingenieure. By B. A. Behrend. Translated by Dr. Paul Berkitz, with notes by Prof. W. Kubler-Dresden. Berlin: M. Krayn. 182 pages, 107 illustrations and 10 plates. Price, 11.50 marks.

A Treatise on Electromagnetic Phenomena. The Compass and Its Deviations Aboard Ship. Vol. II. By Commander T. A. Lyons, U. S. N. New York: John Wiley & Sons. 580 pages, 203 pages. Price, $6.00.

Die Betriebsmittel der Elektrischen Eisenbaum. Von E. C. Zehme. Quarto, 312 pages, 315 illustrations and 66 lithographic plates. Price, 27 marks.

Directory of Electrical Societies, Etc.

American Electrochemical Society. Secretary, C. J. Reed, 929 Chestnut Street, Philadelphia, Pa.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, 95 Liberty Street, New York. Annual meeting, May 19. Papers: "The Experimental Basis for the Theory of the Regulation of Alternators," by B. A. Behrend; "The Heyland Motor," by C. A. Adams, Jr.

American Order of Steam Engineers. Secretary, Frank C. Rose, 10 Federal Street, Pittsburg, Pa.

American Street Railway Association. Secretary, T. C. Penington, 2020 State Street, Chicago. Next meeting, Saratoga Springs, N. Y., September 2, 3 and 4, 1903.

Association of Edison Illuminating Companies. Secretary, W. H. Johnson, Philadelphia, Pa.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Colby and Abbott Building, Milwaukee, Wis.

Canadian Electrical Association. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

Electrical Contractors' Association of New York State. Secretary, Wm. J. Davis, Ithaca, N. Y.

The Electrical Trades Society (Member National Electrical Trades Association). Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

ENGINE BUILDERS' ASSOCIATION. F. P. Ide, Springfield, Ill., Secretary.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Atlantic City, N. J., September, 1903.

INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION Secretary. E. M. Coleman, Louisville, Ky.

NATIONAL ELECTRIC LIGHT ASSOCIATION, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May 26, 27 and 28, 1903.

NEW YORK ELECTRICAL SOCIETY, Secretary G. H. Guy, 104 Liberty Street, New York.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis.

SOUTHERN INDIANA TELEPHONE ASSOCIATION. Secretary, E. W. Pichardt, Huntingburg, Ind.

New Westinghouse Electric Train Control and Couplers.

The following statement has been issued concerning a new Westinghouse system of electric train control:

Important tests have been made of a new system of apparatus for the operation of motors upon the several cars in a train, usually called "multiple-unit control," which the Westinghouse interests have just brought forward. This new Westinghouse apparatus is of the electropneumatic type and is in principle like that supplied

NEW CAR CONTROL APPARATUS ON THE JOHN B. M'DONALD.

to the Brooklyn Rapid Transit Company, for its elevated trains. The improvement consists in arranging within one compact structure the electropneumatic devices to operate simple forms of electric switches, which include a safety circuit-breaking device and automatic means for preventing the application of too great an electric force to the motors, which saves electric current and insures smooth operation of trains.

The simplification which has thus been affected in the most important feature of electric train operation is so great as to make the contrast in appearance between this new form, as attached to a car, and any other kind of control apparatus so striking as to command the immediate attention of railway people who have heretofore regarded unit control apparatus as crude and excessively complicated.

The new control apparatus has all of the usual safety appliances, including the arrangement whereby the current is automatically cut off and the brakes applied, in the event of an accident to the motorman, and, besides, it accomplishes other results not obtainable by any other form heretofore tried, and its weight, being from one-half to three-quarters of a ton per car less, it practically takes the heavier kind out of the running, because the cost of hauling the excess weight of the earlier forms is an interest charge on capital much greater than the first cost of the apparatus.

An automatic car coupling has also been perfected by which the electric connections and brake pipes are united by the same operation, and it is contended that this new coupling will add not only to the safety of employees, but greatly to the facility and convenience in the operation of electric trains.

The Westinghouse Company has placed upon the experimental car of John B. McDonald one of the new electropneumatic unit control systems developed by the Westinghouse Air Brake Company. This apparatus instead of employing a drum controller operated electropneumatically, as in the former type of electropneumatic control, makes use of a series of switches which are individually operated by electropneumatic apparatus of the same character as employed by the Union Switch & Signal Company in operating its electropneumatic signaling system and which have been subjected to years of test in connection with signals on numerous steam railways throughout the country.

The electropneumatic switches are operated progressively by the valves being so arranged as to admit air to their respective operating cylinders at the right time and rate to insure graduated acceleration of the train and also guard against sudden rushes of current. The organization is such that current in excess of a predetermined amount cannot be admitted to the motors, from which it results not only that the motors themselves are not subjected to undue strains, but the train is free from sudden and abnormal movements in acceleration. The valves may be adjusted so that any required degree of acceleration may be obtained. The details of the apparatus have all been thoroughly worked out and tested in connection with the apparatus of the various Westinghouse companies and have survived long periods of practical operation, so that while the organization of the apparatus in itself is new, it is made up of tried and proved apparatus, thus involving no features of uncertainty as to the practical operation of the new system. The Westinghouse interests are fortunate in being thus able to avail themselves of the results of the engineering skill and experience of their several different industries in order to select and apply the best features for effecting the various operations required in the new system. The accompanying figure gives a view of the underside of the car equipped with the new control apparatus. It will be noticed that it is very compact, occupying but a relatively small amount of space, and thus not in any way interfering with the braking and other apparatus required to be placed on the car.

A Long Trolley for Canada.

Mr. Felix S. S. Johnson, United States commercial agent at Stanbridge, Canada, reports as follows: A project for an extensive electric railway system through the south shore counties and eastern townships of Quebec is now in tangible form. It is understood that two main lines will be commenced this season, one to connect Montreal with St. John's by way of Longueuil and Chambly and the other between Montreal and Valleyfield, closely following the river bank and taking in St. Lambert, Laprairie, Chateauguay and Beauharnois. The roads are to be built with heavy tracks and in the most modern way, the cars being 50-odd feet in length, supplied with air brakes and motors capable of running at a speed of between 50 and 60 miles in straight stretches. There will also be parlor coaches for private parties.

It is claimed that this will be one of the largest electric railway systems in Canada, and it will form part of vast plans now being mapped out for an electric road to connect New York with Montreal. It is understood that connections will be made with the important trolley roads in Eastern New York—the Berkshires—and nearly a dozen systems in Vermont. Among the lines that are expected to serve as feeders for the projected main line, besides the Montreal and Southern Counties Railroad, are the Troy Traction Company, the Bennington Hoosick Railroad, the Hudson Valley line, the Troy and New England Company, and the Berkshire Street Railway Company, with about fifteen other corporations of less importance. The scheme is reported to be backed by capitalists from New York, Boston and Chicago. The proposed main line from New York to the Canadian border would pass through much attractive scenery, the shore of Lake Champlain, which it will follow, being particularly beautiful. The Montreal and Southern Counties Railway route will also have the scenic advantages of the Richelieu and St. Lawrence Rivers. It will further enable the farmers all along the south shore to reach the markets of Montreal with their products. The company's intention is to make special arrangements for the carrying of all kinds of farm products between midnight and 6 A. M., thereby allowing the farmers to get their stuff into Montreal in good condition for the morning market.

A Twenty-Ton Switching Electric Storage Battery Locomotive.

The electric storage battery locomotive described below has been designed with special reference to the economical handling of material in mills or other manufacturing establishments. It frequently happens that a single car load of raw material has to be distributed at various parts of the works, and, in such cases, much costly rehandling can be saved by shifting the entire car from point to point, and discharging each portion of the load exactly where it is required. A similar economy can be effected by collecting the finished product at the different buildings, and loading each consignment directly into its proper car. The locomotive in question is used for shifting cars while loading or unloading in this manner, and also for transferring material in course of construction, from one shop to another.

The simple and rugged construction of this locomotive reduces the expense for maintenance to a minimum, probably less than the cost of shoeing the horses which it replaces. The operating expenses consist of the cost of power required to charge the batteries, and the pay of one man. Even if charging current is supplied from an independent steam-driven generator, it is cheaper than any other method of handling cars, as there is no waste of energy when the machine is not in operation.

A locomotive of this type has recently been installed at the works of the Massachusetts Cotton Mills in Lowell, Mass. Previously the cars were shifted, one at a time, by three horses harnessed up

20-TON ELECTRIC STORAGE BATTERY LOCOMOTIVE.

tandem and under the most disadvantageous circumstances owing to the narrowness of passages, situation of tracks, etc. The locomotive is built for the standard 4-ft 8½-in. gauge, and fitted with standard couplings, making it suitable for use with any ordinary railroad car, and on any standard railroad track. The length over the bumpers is 21 ft. 4 in., and the height from the rail head to the top of the cab is 12 ft. 1 in. The wheelbase is 7 ft. 6 in., and permits the operation of the locomotive over a comparatively smaller turntable. It weighs about twenty tons, and runs at a speed of from two to four miles per hour on level track.

As will be seen from the illustration, the locomotive is perfectly "double-ended," the cab being located directly in the center. This makes a very desirable arrangement for switching work, which calls for operation in both directions with equal facility. The batteries are contained in the sloping compartments at either end. This disposition distributes the weight evenly on the four wheels, and, as each of these is a driver, the entire weight of the locomotive is usefully employed in traction. The wheels and axles are driven from the gear cases in the cab by means of Renold silent chains suitably enclosed. These chains are the only portion of the driving gear situated below the car body, the motors and gear cases being mounted in the cab where they are readily accessible, and always under the immediate notice of the operator.

The battery was furnished by the Electric Storage Battery Company, the elements being mounted in tanks of extra depth to prevent the electrolyte from splashing over the top. In mounting the battery special attention has been paid to protecting it against injury due to the shocks to which the locomotive is exposed in switching. There are two motors, specially wound, for the service. By connecting the two motors in series or parallel, and by varying the arrangement of the fields, an efficient speed control is obtained without wasting any of the energy of the battery by passing it through a resistance.

The controller is of the standard vehicle type, and has two levers which control every desired motion of the locomotive. The reversing lever is set to point in the direction in which the locomotive is to move, and the second lever controls the speed. These levers are mechanically interlocked, as in the case of a trolley car controller, so that the motors can only be reversed when the speed lever is in the off position. The locomotive may be run with the controller in any notch, there being no transition point on which a careless operator might leave his lever and burn out the apparatus.

As already mentioned, the speed-reducing gearing is located in the cab, instead of being beneath the car body. All the gears are machine cut, and run in a bath of oil, in fully enclosed gear cases of the C. W. Hunt Company's standard type. The same company's regular flexible and insulated coupling is used for connecting the motor to the gear case. There is a separate gear case for each of the two motors. It will be seen that the driving gear consists of two parts, which are exact duplicates of each other. In an emergency, one motor could be cut out entirely, and the locomotive operated by the remaining motor, but with a reduction of hauling capacity.

The speed reduction of the gear case is so proportioned to the safe discharge rate of the batteries, the safe capacity of the motor and the weight of the locomotive, that neither the batteries nor the motors can be dangerously overloaded. The driving axles are made to standard dimensions, and run in "Hunt" patent roller bearings, which reduce the friction at these points to an inappreciable amount. The wheels are shrunk in place, and have chilled treads and flanges of M. C. B. standard size and shape. A powerful brake is conveniently located in the cab. An alarm gong is also provided.

Experience has shown that in light switching service, the batteries can be recharged at various times during the day while the locomotive is waiting between hauls. For heavier service, it may be necessary to charge during the noon hour or after working hours in the evening. The battery is automatically protected during charging by well-known safety appliances, which open the circuit if the current is excessive, and also when it drops so low as to indicate that the battery is fully charged. The precise arrangement of the charging station depends very largely on the details of the electric plant available, and the builders of the locomotive are glad to advise their customers as to the methods to be employed in each particular case.

Switchboard Speed Control of Water-Wheel Governors.

In the operation of multiple-unit plants it is often a great convenience, and sometimes almost a necessity for the switchboard attendant to be able to exercise control over the speed of any one unit. This applies equally to plants operated by water power and by steam. We illustrate a device for this purpose by means of which attachment when applied, for example, to a water wheel, the speed at which the governor holds the wheel can be gradually raised or lowered, or the wheel can be completely shut down if desired. The former is convenient when getting two or more generators into step or for varying the relative load carried by two generators when running in multiple, while the latter is useful in the

event of accident or other emergency necessitating a quick shutdown.

The apparatus consists of a small reversible motor connected by double-reduction worm gearing to the bracket carrying the controlling lever of the governor. This bracket is given an endwise movement by the motor, which, by shifting the position of the controlling lever, varies the speed at which the governor holds the wheel. The illustration gives a view of the governor to which the motor is attached. The switch on the switchboard to the control motor has two buttons for raising and lowering the speed, and a small thumb switch for completely disconnecting the apparatus when not in use. The latter has three contacts, one of which is used for quickly shutting down the unit without the attendant being obliged to keep the push button depressed while this is taking place. The motor is furnished with automatic cut-outs, which prevent its overrunning after the limit of movement of the lever is reached.

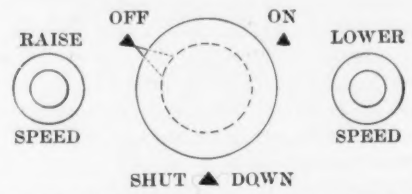


FIG. 1.—CONTROL OF WATER WHEEL GOVERNOR.

In some instances the controlling switch is placed in a remote plant instead of in the plant where the governor is working, when two such plants run in multiple and it is desired to synchronize or otherwise control the speed from a single station. A detailed description and the method of operaiton of this governor was published in the issue of May 17th, 1902, and since that time a number of improvements have been made.

The governors are made in several sizes to suit different sizes of wheels. Where sufficient head of water is available, this pressure can be employed to operate the governor, but where this is not the case an oil-pumping system distinct from the governor is employed. The pump used for this purpose is of special construction adapted for governor purposes. The pump is fitted with two reciprocating plungers operated by a crank which works in an enclosed oil-tight chamber. The pump is driven by a pulley from the water wheel shaft and can be located in any position irrespective of the position

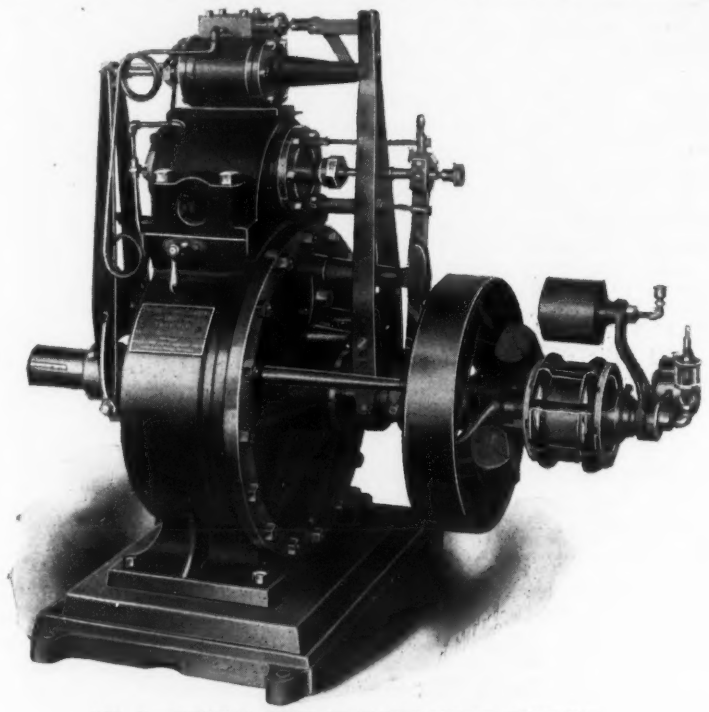


FIG. 2.—GENERAL VIEW OF WATER WHEEL GOVERNOR.

of the governor. A receiver is provided to hold the oil under pressure for serving the governor.

Among the plants which are now being equipped with these governors and electrical controlling attachments are the Rochester Gas & Electric Company, Rochester, N. Y., on their 6,000-hp installation; the Union Carbide Company's plant at Sault Ste Marie, Mich.; the St. Joseph River & Elkhart Power Company's plant at Mishawaka, Ind.; the York Haven Power Company, on the Susquehanna River, and many others. These governors are manufactured by the Sturgess Governor Engineering Company, Troy, N. Y., which has made a specialty of this business.

Pillsbury Alternating Current Ceiling Fan.

We illustrate herewith an alternating-current ceiling fan embodying a number of new features. Fig. 1 is a general view of a two-blade fan showing its external appearance, and Fig. 2 shows the construction in detail.

The revolving armature, *E*, is on the outside, which makes a very simple construction. The blades are attached directly in the sockets, *K*. The weight of the armature is supported on a ball bearing consisting of the two hardened steel washers, *F* and *G*, and the hardened steel balls, *H*. These balls are held in a cage so that they cannot

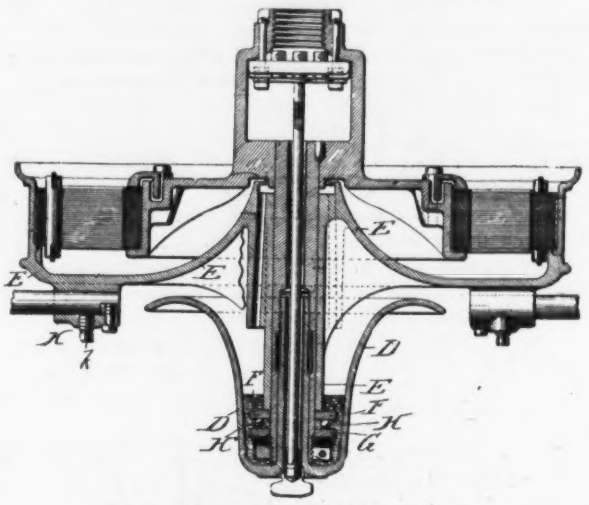


FIG. 1.—DIAGRAMMATIC VIEW OF FAN.

be misplaced or lost if the ball bearing is removed. The bell-shaped oil cup, *D*, has a tube in the center extending up into the hollow shaft above the oil level and screwing into a thread inside the shaft. By this arrangement the oil cup can be unscrewed and removed without spilling the oil. All details are, in fact, arranged for the greatest convenience in installation and care.

These fans are claimed to be as efficient as direct-current fan motors, the four-bladed ones moving fully as much air as direct-current types of ceiling fans. The power factor is exceptionally high

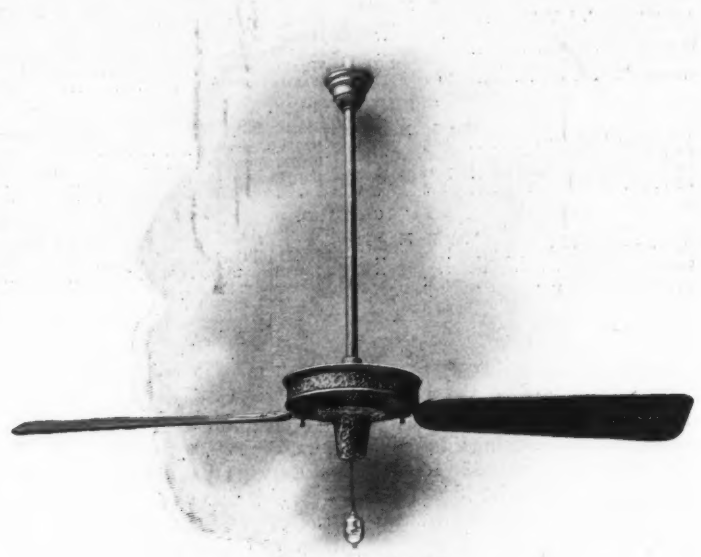


FIG. 2.—ALTERNATING-CURRENT CEILING FAN.

for a motor of this class, about 65 per cent. These results are secured by the use of the multiple-tooth filed pole, of graduated strength, for which, in conjunction with a phase or starting coil, a patent was granted to Mr. Pillsbury, dated January 30, 1900. His work on single-phase motors was highly commended last year by the Franklin Institute, which granted a medal to the Wagner Electrical Manufacturing Company, for the improvements in its Pillsbury-Schwedtmann single-phase power motors, which it has been building for the last five years.

The ceiling fan described is manufactured by the H. E. Lindsey Electrical Supply Company, of St. Louis.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was freely offered by brokers and a fair-sized business was done. The closing rates were 4¼ per cent. for 60 to 90 days, 4½ per cent. for four, five and six months, and 5 per cent. for eight months. In the stock market there was a striking loss in volume of business as compared with the corresponding week in the two preceding years. The market opened with a better feeling and advancing prices, but it soon lapsed into dullness and inactivity, no interest being shown either by the speculative element or by outsiders. Electrics and tractions shared in the general dullness and no marked feature was exhibited in either line. In the outside market, trading in copper stocks was on a very small scale, but prices generally held firm. The sales of Brooklyn Rapid Transit aggregated 29,160 shares, the closing price being 65½, which was the lowest of the week, and representing a net loss of ½ point. Metropolitan also closed at the lowest figure, which was 132, being a net loss of 1½. The sales aggregated 21,750 shares. General Electric fluctuated within narrow limits, the highest quotation being 194, and the lowest 193½, closing at 193¾, being a net gain of ¼ point. The transactions were limited, aggregating 3,720 shares. Westinghouse common made a net gain of 3 points, closing at 213, after reaching 220 at one time during the week. Western Union made a net gain of ½ point, closing at 85½. There was little activity in this stock, the number of shares sold being 1,630. American Telegraph & Cable closed at 81, being a net loss of ¾, and American Telegraph & Telephone 159¼, a net gain of 5¼ points. Following are the closing quotations of May 12:

NEW YORK.

	May 5.	May 12		May 5.	May 12
American Tel. & Cable	80	80	General Electric	192	193¾
American Tel. & Tel.	158	155	Hudson River Tel.	..	..
American Dist. Tel.	31	30	Metropolitan St. Ry.	134¼	131
Brooklyn Rapid Transit	66¾	65⅝	N. E. Elec. Veh. Trns.	¼	⅛
Commercial Cable.	..	..	N. Y. & N. J. Tel.	..	..
Electric Boat	22	20	N. Y. E. V. T. Co.	..	7
Electric Boat pfd.	37	41	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction.	1¾	1¾	Western Union Tel.	85¼	85¼
Electric Vehicle.	11¾	11	Westinghouse com.	210	210
Electric Vehicle pfd.	15	15⅝	Westinghouse pfd.	210	210

BOSTON.

	May 5.	May 12		May 5.	May 12
American Tel. & Tel	158¾	157	Western Tel. & Tel. pfd.	98	98
Cumberland Telephone.	..	..	Mexican Telephone.	2⅛	2
Edison Elec. Illum.	..	..	New England Telephone	138	137½
General Electric.	..	192	Westinghouse	..	105
Western Tel. & Tel.	19	19⅛	Westinghouse pfd.	..	104

PHILADELPHIA.

	May 5.	May 12		May 5.	May 12
American Railways	49½	48½	Phila. Traction.	97⅛	96¾
Elec. Storage Battery	74*	74*	Phila. Electric	7⅛	7⅜
Elec. Storage Battery pfd.	74*	74*	Pa. Electric Vehicle.	..	..
Elec. Co. of America.	8⅞	8⅞	Pa. Electric Vehicle pfd	..	..

CHICAGO.

	May 5.	May 12		May 5.	May 12
Central Union Tel.	..	..	National Carbon pfd.	97	96
Chicago Edison.	..	..	Northwest Elev. com.	..	..
Chicago City Ry.	206½	205	Union Traction	5⅛	4
Chicago Tel. Co	..	..	Union Traction pfd.	32	32
National Carbon	24	24⅛			

*Asked.

NEW ENGLAND TELEPHONE.—The New England Telephone Company has issued its annual report for the year ended December 31, 1902. The gross revenue was $6,024,609, an increase of $847,197, while the net earnings were $1,168,769, an increase of $131,286. The expenditures for new construction during the year amounted to $1,895,909, of which $371,810 was for aerial construction, $649,115 for underground conduit and cables, $387,771 for toll lines and $487,211 for equipment. The expenditure for plant and equipment was as follows: For new construction and proportion purchase, $1,895,909; for repairs and maintenance, $2,045,987; total, $3,941,896, as against an expenditure in 1901 of $3,801,383. The exchange stations December 31, 1902, numbered 100,864, an increase of 16,282; private line stations, 6,744, an increase of 45. The number of regular employees of all classes is 3,894, of whom 1,737 are males and 2,157 are females. It is estimated that the expenditures for maintenance and extensions of property during 1903 will be: For new construction, $1,800,000; for maintenance, $2,200,000; total, $4,000,000.

WESTINGHOUSE ELECTRIC STOCK.—The holders of record of the stock of the Westinghouse Electric & Manufacturing Company at the close of business on May 23, 1903, are offered the privilege of subscribing to $4,500,000 of new "assenting" stock at $80 per share of $50, at the rate of one share of such new stock for every four shares of existing stock. Subscriptions must be made before 3 o'clock P. M., on Monday, June 8, 1903, at the office of the company, No. 120 Broadway, accompanied by a check for $30 for each share subscribed for. The balance of the subscription will be payable as follows: July 23, 1903, $25 per share; September 14, 1903, $25 per share. The company did the enormous business last year of just $24,000,000, and the new capital is necessary to meet the even greater business ahead.

GENERAL ELECTRIC OFFICERS.—The annual meeting of the stockholders of the General Electric Company took place at Schenectady on May 12. The number of directors was increased from thirteen to fifteen, according to the plans already prepared, and other important business was transacted. The representation of shares was to the number of 308,000. These were re-elected directors: Gordon Abbott, Oliver Ames, C. A. Coffin, T. Jefferson Coolidge, Jr., Frederick P. Fish, George P. Gardner, Eugene Griffin, Henry L. Higginson, J. Pierpont Morgan, J. P. Ord, Robert Treat Paine, second, George Foster Peabody and Charles Steele. Ex-Governor William M. Crane, of Massachusetts, and William C. Whitney, of New York, were elected to fill the two new directorships created at this meeting by an amendment of the by-laws.

THE NEW JERSEY ELECTRIC MERGER.—Articles of incorporation of the new trolley, gas and electric consolidation, which will be known as the Public Service Corporation of New Jersey, were filed for record in the County Clerk's office at Newark, N. J., last week. The concern is capitalized at $25,000,000 in shares of $100 each, while the paid-up capital will be $100,000. The incorporators are Thomas N. McCarter, ex-Attorney-General, who holds 334 shares; Thomas Dolan, presideint of the United Gas Improvement Company of Philadelphia, who holds 333 shares, and John I. Waterbury, of Morristown, who holds 333 shares. Mr. McCarter, who will be president of the new concern, is named as the local representative with offices in the Prudential Life Insurance Company's Building.

UNITED GAS IMPROVEMENT.—At the United Gas Improvements annual meeting last week the annual report showed net profits for the fiscal year ended December 31, 1902, of $3,473,643, an increase of $938,354 over the previous year. Comparison of the last two years shows net earnings $3,473,643, against $2,535,288. The sales of gas have increased over 1901 22½ per cent., and the business of the electric light and trolley companies 11 per cent. and 7½ per cent., respectively. Directors have been elected as follows: Clement A. Griscom, William L. Elkins, W. W. Gibbs, Randall Morgan, George Philler, Samuel T. Bodine, Thomas Dolan. The ticket was elected by a vote of 482,740 shares out of a total of 564,968. President Dolan was elected by the same vote.

UNITED RAILWAYS OF SAN FRANCISCO.—The stockholders of the United Railways Investment Company, of San Francisco, which controls the street railway systems of San Francisco, held their annual meeting last week in Jersey City. The balance sheet as of December 31, 1902, showed a cash balance of $13,431, after setting aside sufficient to meet the payment of the dividend which was paid January 3. There was also submitted a report of the operating company giving the balance as of December 31. The profit and loss account of the operating company covering the period of the corporation from March 20, 1902, to December 31, 1902, showed a surplus of $572,404.

CHICAGO UNION TRACTION.—The *Chicago Times* says that the terms under which the Union Traction Company of Chicago is to be organized after its receivership are gradually being outlined. Renewals of franchise for the north and west side systems will be asked for in the names of the North & West Chicago Street Railway Companies. The Union Traction will continue a leasing and operating company. As rent for the properties it will agree to pay fixed dividends on the North and West Chicago stock, probably 8 per cent. for the North side and 4 per cent. for the West and assume all existing bonds and other obligations.

CANADIAN WESTINGHOUSE.—It is stated that the Westinghouse Electric & Manufacturing Company contemplates forming a Canadian company to supply that market. The Westinghouse Air Brake Company will be interested. The capital of the company will be $2,500,000, of which the Air Brake Company will have $850,000, and the Electric Company $950,000, the remainder of the capital stock being taken at par by Canadians. Westinghouse electrical interests have for many years past been efficiently represented in Canada by Ahearn & Soper, of Ottawa.

DIVIDENDS.—The Lynn (Mass.) Gas & Electric Light Company has declared an extra dividend of 25 per cent. with its regular quarterly disbursement of 2½ per cent., which extra calls for the payment of $143,750. The directors of the Consolidated Gas Company of New York have declared the regular quarterly dividend of 2 per cent., payable June 15. The directors of the Niles-Bement-Pond Company have declared the regular quarterly dividend of 1½ per cetnt. on the preferred stock, payable May 15. The directors of the Pratt & Whitney Co. have declared the regular quarterly dividend of 1½ per cent. on the preferred stock, payable May 15.

CINCINNATI GAS & ELECTRIC COMPANY.—A director of the Cincinnati Gas & Electric Company is quoted to the effect that the demand for gas and electricity is the greatest in the history of the city. Some $300,000 have been spent in improving the facilities of the company and the benefit of this expenditure is just being felt. The proposed increase of $2,000,000 in the capital of the company will probably be voted on favorably at the annual meeting this week.

HAVANA TROLLEYS.—A special meeting of the stockholders of the Havana Electric Railway has been called for June 4 to consider the question of authorizing the use for purposes of construction, equipment or improvements of $250,000 out of $2,500,000 consolidated mortgage bonds reserved for future corporate improvements.

Commercial Intelligence.

THE WEEK IN TRADE.—Favorable reports were made to the mercantile agencies, although the labor situation is not encouraging. A large business continues generally, and industry is active, in most cases surpassing that of previous years at this time. Reports of the late cold wave are now coming in and show that crops of all sorts were arrested in nearly all sections. In labor matters, spring unrest seems to have culminated in strikes or lockouts of fully 100,000 men in the first week in May, double that number becoming idle the last week in April. Railway earnings in April were 13.4 per cent. larger than those of April last year, and 28.7 above 1901. The business failures during the past week aggregated 175, against 173 in the preceding week. Copper is still nominally 14¾ to 15c., but actual business would be done considerably lower, if any occurred. The metal was extremely dull, however, and no business was reported. In the iron and steel industry, cancellation of orders where deliveries failed to be made according to contract, and new business at lower quotations, indicate a tendency toward more normal conditions in pig iron. There has been a constant menace in the price situation, which restricted domestic trade and operated even more strongly against foreign commerce. Pending contracts for about 50,000 tons of structural material have been closed and other orders are only postponed by uncertainty regarding the labor situation. Railway requirements appear to have no limit; implement manufacturers are surpassing all records in their purchases of merchants' steel; machine shops are working at full capacity and all leading machinery markets report satisfactory conditions.

LARGE ELECTRIC CRANES FOR LOCOMOTIVE SHOPS.—Manning, Maxwell & Moore have recently secured, on behalf of the Shaw Electric Crane Company, of Muskegon, Mich., several important contracts for electric traveling cranes to be installed in various new railroad locomotive shops. A 120-ton crane has been ordered for the Pittsburg & Lake Erie shops at McKees Rocks, Pa. This crane will have two 60-ton trolleys. The span will be 65 ft. The equipment will be operated by a 215-hp motor, also of Shaw manufacture. For the new shops of the Pennsylvania Railroad at Wilmington, Del., five cranes have been ordered varying in capacity from 65 tons to 15 tons. Two 65-ton cranes, with double auxiliary hoists, will operate on a span of 76 ft. They will be driven by 130-hp motors. Two 15-ton cranes will travel over a 47-ft. span. They will be operated by 35-hp motors. A 20-ton crane for a 47-ft. span has also been ordered for the same shops. It will be worked by a 45-hp motor. Two 65-ton cranes, with double-auxiliary hoists of 7½ tons capacity each, fitted on trolleys, have been ordered by the Pennsylvania Railroad for the Renovo (Pa.) shops now under construction. These outfits will be operated by 130-hp motors. The span will be 76 ft. A 75-ton crane for a 77-ft. span, and to be operated by a 150-hp motor, has been contracted for by the same railroad for installation in its Columbus (Ohio) shops. Five 5-ton Shaw cranes to operate over an 84-ft span have been ordered by the new Wilmington Malleable Iron Works, which plant is to be electrically operated throughout.

AMERICAN DISTRICT STEAM COMPANY.—This active and prosperous concern, of Lockport, N. Y., has been doing a large business with its Holly system of utilizing direct and exhaust steam for heating. During the last year it installed 35 new steam heating plants, besides extensive additions to many other plants previously installed, and the outlook for its business so far this year is very much better than last. Owing to unprecedented demands for its goods, it was compelled to double its manufacturing plants at Lockport and also at North Tonawanda. It is just now engaged in installing plants at Birmingham, Ala.; Baltimore, Md.; Paducah, Ky.; Decatur, Ill.; Ebensburg, Pa., and Bangor, Pa., and in making extensive additions to large plants installed two years ago at Atlanta, Ga., for the Georgia Railway & Electric Company, also additions to the plant at Bristol, Conn. The general public is demanding a supply of heat from central stations, and the system of exhaust steam heating through underground mains is filling that want. It also enables electric companies who install the system to meet competition that may arise through other methods of lighting and enables them to sell their steam for more than enough to pay all fixed charges, practically securing their current at the station without exepense. It also enables them to increase their electric business by being in a position to furnish steam heat, electric light and power to large blocks that now have their own boilers, engines and dynamos.

THE PNEUMATIC SIGNAL COMPANY, Broad Exchange Building, New York, has purchased from Mr. S. Marsh Young, owner of the Young system of automatic electric track circuit block signals for electric railways, all his rights for the United States, Canada and Mexico, and will arrange to place the system at once on the market. The Young system furnishes the same measure of protection for electric lines as the standard track circuit system does on steam roads. The presence of any pair of wheels on the block section, a broken rail or wire, or an open switch results in a danger signal. The Signal Company will organize an electric railway department which will be in charge of Mr. Young. It will be remembered that Mr. Young was one of the incorporators and the first vice-president of the Hall Signal Company and was for some years the vice-president and general manager of the Manhattan General Construction Company, until he sold the company to the Westinghouse interests. The Pneumatic Signal Company's factory has been until recently at Troy, but they are now moving into their new works at Rochester, N. Y. This plant will cover about 240,000 sq. ft. of floor space. The system by which this company is best known is its low-pressure pneumatic system for interlocking and block signals on steam railway lines, used in Europe and America. Their entering the street railway field is a new departure.

BUCKEYE ENGINE ORDERS.—The Buckeye Engine Company, of Salem, Ohio, New York offices Taylor Building, has secured a contract for a 20-in. x 36-in. x 33-in. and a 15¼-in. x 26½-in. x 27-in. compound engine for the new Moline (Ill.) shops of the Chicago, Rock Island & Pacific Railroad. The engines are for light and power work. A 20-in. x 21-in. simple engine has been ordered for light and power use by the Passaic (N. J.) Steel Company. The Alms & Doepke Company, of Cincinnati, Ohio, has requisitioned for a 14¼-in. x 16-in. simple engine, also for light and power purposes. The National Steel Company, of New Castle, Pa., has ordered a 22-in. x 38-in. x 33-in. compound engine. A 16½-in. x 26½-in. x 24-in. compound is to be built for the Ashland Iron & Steel Company, of Duluth, Minn. Two 18¾-in. x 21-in. simple engines are to be shipped the National Mining Company, of Traveskyn, Pa., for light and power and the Fairmount Coal Company, of Monangah, W. Va., has ordered three engines of similar size for direct connection to generatnrs.

DE VEAU TELEPHONE APPARATUS.—The De Veau Telephone Manufacturing Company, of 27 Rose Street, New York City, has been extremely busy of late making installations of their apparatus. Among places furnished are the fine new New York Stock Exchange Building, as illustrated recently in these pages. Other places are Blair Building, Broad Street, New York; Potter Hotel, Santa Barbara, Cal.; Carvel Hall Hotel, Baltimore, Md.; White House, Washington; Clarence G. Mackay residence, Roslyn, L. I.; Norfolk Navy Yard, Brooklyn Navy Yard, New York Post Office, New York Chamber of Commerce. Mr. A. S. De Veau reports also that they have furnished in the exchange line complete central energy plants to the Safety Electric Manufacturing Company, New Orleans, and E. Baker, Mount Olive, Va. They have also just extended the plant of the Baiting Hollow (N. Y.) Telephone Company. Mr. Gilpin, of the company, has just started out again on a long business trip.

TELPHERAGE FOR SWEDEN.—The United Telpherage Company, 20 Broad Street, New York, has just made an arrangement with Messrs. Aktiebolaget, Landens Hissar, and Messrs. Luth & Rosens, of Stockholm, Sweden, for the manufacturing and exploiting of telpherage business in Norway, Denmark and Sweden. The above firm will manufacture and install telpherage plants under the same system as that of the United Telpherage Company of United States. Arrangements have also been made for manufacturing and introducing telpherage apparatus in Great Britain and the Colonies, with Messrs. Siemens Brothers & Co., Limited, of London, England, and arrangements are also being completed with other large electrical manufacturing companies on the Continent.

The application of telpherage to the handling of material for manufacturers and for railway and steamship lines, in connection with terminal freight bids fair soon to become an enormous industry.

ROCK ISLAND LOCOMOTIVE SHOPS.—The Chicago, Rock Island & Pacific Railroad's new shops at East Moline, Ill., are to be installed with considerable electrical equipment. The contract for the generators has been awarded to the General Electric Company. The Buckeye Engine Company will build the engines. The boilers are to be of B. & W. type. Eight electric traveling cranes are to be put in by the Shaw Electric Crane Company. There will be two 50-ton cranes operating over a 95-ft. span, with auxiliary hoists of 6-tons capacity. Shaw motors of 135 hp will drive each of these outfits. A 10-ton crane for a 44-ft. span, to be driven by a 35-hp motor; a 20-ton crane for a 55-ft. span, to be operated by a 60-hp motor; a 5-ton crane also for a 55-ft. span, to be worked by a 20-hp motor; two 3½-ton cranes for a 44-ft. span, to be driven by 18-hp motors and a 5-ton crane for an 80-ft. span, to be operated by an 18-hp motor, have also been ordered.

USE OF NERNST LAMPS.—The streets of the City of Madison, Wis., are being illuminated with Nernst lamps. Some of the business men in one of the blocks on East Main Street put in five of these lamps independent of the city arc lights at each end of the block, making that section of the city a blaze of electric light. The absence of flicker in the Nernst lamp and the fact that it casts no shadow on the street make it especially adaptable for out-door lighting, and the occupants of the adjoining block to the west were not slow in also making arrangements for five of the lights. It is highly probable that the other blocks in this vicinity will adopt the same plan and that finally the capitol will be encircled with these effective little street lamps. The Public Library at Waterbury, Conn., is to be lighted with Nernst lamps, furnished by the Nernst Lamp Company of Pittsburg, Pa.

STEAM TURBINES AT HARTFORD, CONN.—The steam turbine plant of the Hartford Electric Light Co., Conn., which at present consists of a 2,000-hp set, is soon to be duplicated by machines built by the contractors for the original installation, the Westinghouse Machine Company. This was the first American plant where steam turbine units of large size were installed, and their complete success must be highly gratifying to the makers. In its application to the generation of electrical power the Westinghouse steam turbine is undoubtedly making marked progress. As an evidence of the energy with which the manufacture of these machines is being taken up, it may be interesting to state that the aggregate power of steam turbine sets completed, in hand and in order to the Westinghouse Machine Company does not fall far short of 200,000 kw.

HARRISBURG ENGINE ORDERS.—Mackenzie, Quarrier & Ferguson, Incorporated, 114 Liberty Street, has taken a contract for a 14-in. x 13-in. Harrisburg standard simple engine for installation in the plant of the Pennsylvania Salt Manufacturing Company at Philadelphia. The engine is to be direct-connected to a 75-kw Crocker-Wheeler generator for lighting purposes. Three 13-in. x 14-in. direct-current Harrisburg standard simple engines have been ordered for the Scioto Valley Pool, Columbus, Ohio, to drive three 100-kw exciter generators. A 13½-in. x 21-in. x 15-in. tandem-compound Harrisburg standard engine has been ordered by the American Locomotive Company for its Alleghany (Pa.) plant. This engine is to be direct-connected to a 100-kw General Electric generator for light and power.

HUGE CEMENT PLANT.—The Quaker Portland Cement Company's plant, to be constructed at Sandt's Eddy, Pa., which is to be the largest in the United States, will be electrically operated. The initial capacity of the plant will be 5,000 barrels per day. Contracts have already been placed for the boilers, engines and conveying machinery. The boiler contract, which calls for a 4,000-hp equipment in eight units of 500-hp each, has been allotted to the Heine Safety Boiler Company. The engines will be built by the Allis-Chalmers Company. They will be of Reynolds Corliss type, the conveying machinery will be built by the Webster Manufacturing Company, of Chicago, Ill. R. Sherwood Dunn, of the Standard Oil Company, is the head of the Quaker Company. Professor Carpenter is the consulting electrical engineer.

EUROPEAN RAILS FOR MANILA ELECTRIC ROAD.—The rails to be utilized in the construction of the Manila electric traction system will be of European manufacture. J. G. White & Co. have awarded the contract to Wonham & Magor, 29 Broadway, New York, who secured the work on account of the British steel jobbing house of Suren, Hartmann & Co., of London. There will be about 30 miles of 70-pound T-rails and 10 miles of 7-in. girder rails, representing an aggregate weight of 4,000 tons approximately. Delivery is to be completed inside of five months. The bulk of the material will be turned out by Belgian and German mills.

THE UNION IRON WORKS, of San Francisco, are installing a power transmission plant near Reward in Inyo County, Cal., from which they will transmit power electrically over a distance of about two miles to the mill of the Reward Gold Mining Company, where induction motors will be used to drive a 20-stamp mill, an air compressor, and a rock breaker. The apparatus, which has been purchased from the Westinghouse Electric & Manufacturing Company, includes a 120-kw, three-phase alternator; a 2-hp exciter, a switchboard panel, including voltmeters, ammeters, rheostats, etc.; two 50-hp induction motors, complete with auto-starters, slide rails, etc.; a 15-hp induction motor, three 7½-kw transformers, two 1-kw transformers, and eight lightning arrester units. The transmission will be at 2,200 volts.

NERNST LAMP INSTALLATIONS.—The Atlas Tack Company has recently installed a large number of Nernst lamps, made by the Nernst Lamp Company of Pittsburg, in its factory at Fairhaven, Mass. Swift & Co., Union Stock Yards, Chicago, are lighting their temporary offices with the Nernst lamp. Two hundred and eighty-five 3-glower lamps are used, doing away with all desk lights and other local units. It is understood that this trial of Nernst lamps has proven so satisfactory that they will be used throughout the large permanent office building now under course of construction.

LIDGERWOOD ELECTRIC HOIST ORDERS.—The Lidgerwood Manufacturing Company, of 96 Liberty Street, New York, has secured a contract for three electric mining hoists from the Thomas Iron Company, of Hokendauque, Pa. There will be two single-drum equipments, each operated by a 75-hp General Electric motor, and one double-drum hoist, which will be driven by a 100-hp General Electric motor. The Metropolitan West Side Elevated Railroad, Chicago, has ordered a small Lidgerwood hoist to be operated by a 12-hp General Electric motor.

STROMBERG-CARLSON TELEPHONE PLANTS.—The Stromberg-Carlson Telephone Manufacturing Company, Chicago, has recently sold telephones and material to the Yantisville Telephone Company, Yantisville, Ill., and the O'Dell Farmers' Telephone Company, O'Dell, Ill. It has also just completed the installation of a 4,800 ultimate capacity lamp line multiple switchboard with 2,400 lines present capacity for the Interstate Telephone & Telegraph Company, at Springfield, Ill. That company has nearly completed its underground system, which extends over the major part of the city.

EQUIPMENT FOR AMERICAN TYPE FOUNDERS' COMPANY'S NEW PLANT.—The American Type Founders' Company, of 27 William Street, New York, has just let contracts through Edward R. Knowles, electrical engineer, for various equipment to be installed in its new plant at Communipaw, N. J., which is to be electrically operated. Two 125-hp Skinner engines have been ordered from the A. D. Granger Company, White Building, Liberty Street. The C. & C. Electric Company will build two direct-current generators of 75-kw capacity each.

BALL ENGINE ORDERS.—The Northern Electrical Manufacturing Company has recently placed in operation at its works at Madison, Wis., a 300-hp cross-compound self-oiling engine, arranged for direct connection to two 75-kw Northern generators. The Ball Engine Company, Erie, Pa., is supplying the engines. The Ball Engine Company has also recently sold to the Perry-Buskirk-Matthews Stone Company, of Bedford, Ind., a 200-hp engine, arranged for direct connection to 125-kw Western Electric generator.

THE AMERICAN PUSH BUTTON TELEPHONE COMPANY has taken new offices in the Electrical Exchange, 136 Liberty Street. This company reports considerable new business, including an order for $3,000 worth of telephones, from one of the prominent railway companies. Mr. W. V. Sweeten, manager of this concern, is planning to take a trip June 1 as far west as the Pacific coast, with its new type telephone, which is a decided improvement over the old style.

BRAZILIAN PLANT TO BE EXTENDED.—The electrical plant at Manaos, Brazil, which is operated by the Brazilian interests of Blytton Brothers, Coffee Exchange Building, New York, is to be enlarged. A 60-kw alternating-current generator of General Electric build, and a Harrisburg engine of 90-hp capacity will be installed. The boiler and induced-draft apparatus will be furnished by James Beggs & Co.

FIELD TELEPHONE AND TELEGRAPH SYSTEM FOR CUBA.—The Manhattan Electrical Supply Company, 32 Cortlandt Street, has secured a large contract for a telephone and telegraph system which is to be used in connection with the construction of an extensive railroad system in Cuba.

MEXICAN LIGHTING PLANT.—An electric lighting plant is to be installed at Lagos, located in the State of Jalisco, Mexico. Water power will be employed to generate the current. Madero & Co., of Parras, in the State of Coahuila, are primarily interested in the project.

General News.

THE TELEPHONE.

EUREKA, CAL.—Mr. W. E. Herron, representing the American Electric Telephone Company, of Chicago, has petitioned for a telephone franchise in this city.

SAN BERNARDINO, CAL.—The San Bernardino Traction Company is installing a telephone system on its lines between San Bernardino and Redlands. Each car is provided with a telephone.

DOVER, DEL.—The Bourbon County Telephone Company, a Kentucky concern incorporated in this state, has certified to an increase in its capital stock from $75,000 to $130,000. The headquarters of the company are in Lexington, Ky.

JACKSONVILLE, FLA.—The Southern Bell Telephone Company is considering the erection of a long distance line from Jacksonville, Fla., to Lake City and other towns.

ATLANTA, GA.—It is said that the reorganized Standard Telephone Company in Atlanta is planning long distance connections throughout the state and adjoining states. The new concern will be known as the Atlanta Telephone and Telegraph Company. A new switchboard with a capacity of 7,200 subscribers will soon be installed.

HONOLULU, H. I.—The Hawaii Telephone Company, of Wailuku, Maui, has been incorporated by S. Shmi, J. P. Sylva and Y. You. The place of business is Wailuku.

KEOKUK, IA.—The Iowa Telephone Company proposes to place its wires underground in this city.

ODGEN, IA.—The Odgen Telephone Company, with a capital stock of $25,000, has been incorporated.

RADCLIFFE, IA.—At the recent election a favorable vote was cast for granting a franchise to the Radcliffe Telephone Company.

CENTREVILLE, IA.—The Appanoose County Telephone Company has been formed with a capital stock of $60,000. It is a re-organization of the Centreville Telephone Co. Extensions and improvements to the system are to be made.

GIBSON, ILL.—The Gibson Telephone Company has changed its name to Granger Mutual Telephone Company.

HILLSBORO, ILL.—The People's Mutual Telephone Company has increased its capital stock from $5,000 to $10,000.

COTTAGE GROVE, ILL.—The Cottage Grove Independent Telephone Company will build a toll line between Equality and Eldorado.

EFFINGHAM, ILL.—The E. Watson & Gilmore Telephone Company has been incorporated and the following-named offices have been elected: President, Geo. Kincaid; secretary, Mantz McCallen; treasurer, J. W. Phillips.

METROPOLIS, ILL.—The farmers of Massac and Pope counties have formed a mutual telephone company which will build lines throughout the two counties.

CHICAGO, ILL.—Another suit attacking the right of the Chicago Telephone Company to charge more than the franchise rate of $125 a year for the use of its telephones for business purposes has been filed in the Circuit Court. Thirty business firms and individuals are complainants in the new bill, and the allegation is made that the company has been exacting $175 a year. The complainants ask an injunction to restrain the company from charging more than $125 a year and from refusing to furnish them with its service. It is reported that more than 1,000 new subscribers were secured by the company during the month of April.

PAOLI, IND.—The Hoosier Telephone Company's exchange in this place will be enlarged. A 200-drop switchboard will be installed and other improvements made.

VEDERSBURG, IND.—The Vedersburg Telephone Company, with a capital stock of $25,000, is a newly-organized company. Mr. D. T. Heffner is one of the directors.

UPLAND, KAN.—The Farmers' Mutual Telephone Company has been incorporated with a capital stock of $5,000.

OWENSBORO, KY.—The directors of the Kentucky & Indiana Independent Telephone Companies, of Owensboro, Rockport, Ind., and Louisville, held a conference recently for the purpose of arranging a circuit to connect the three cities. It is probable that a cable will be laid across the river at Rockport.

NORVELL, MICH.—The Brooklyn & South Norvell Telephone Company, of Norvell, has been incorporated with a capital of $500.

LITCHFIELD, MICH.—The Litchfield Farmers' Mutual Telephone Company has been incorporated with a capital stock of $2,000.

DETROIT, MICH.—The Huron Valley Telephone Company has been organized by farmers in the vicinity of Milford. The lines of the company will be connected with the Milford exchange. The organizers are C. E. Bourns, W. T. Bourns, C. B. Atkin, H. Peters, C. L. Pearson, Chas. Eno, Chas. Foote and W. K. Foote.

CAMDEN, MICH.—The Camden Rural Telephone Company has been incorporated with a capital stock of $10,000 and will build a line from Camden to Reading.

AUSTIN, MINN.—The Interstate Telegraph & Telephone Company, of Austin, has been incorporated with a capital stock of $60,000. The incorporators are James Keenan, John L. Gulden, Seymour Johnson, Thomas A. Revord, Charles A. Sterling.

BLACKDUCK, MINN.—The Blackduck Electric & Telephone Company will erect a brick building for a power station and telephone exchange.

KASOTA, MINN.—James Bennett has been granted a franchise for a telephone exchange in this place.

HANNIBAL, MO.—The Hannibal & Ralls County Telephone Company has been incorporated, with a capital stock of $1,000. S. B. Crook is one of the directors.

RED LODGE, MONT.—The Montana & Wyoming Telephone Company has increased its capital stock from $40,000 to $100,000, and will build a line from Billings to Bozeman.

ARLINGTON, NEB.—The Arlington Telephone Company has been incorporated with a capital stock of $10,000. The directors for the first year are C. Marshall, A. G. Ludwig, H. W. Marshall, Henry Hilgenkamp, H. L. W. Reckmeyer, A. G. Unland and C. Vail.

CHARLOTTE, N. C.—The Southern Bell Telephone Company at Charlotte has decided to extend its service into the county.

RALEIGH, N. C.—The Interstate Telephone Company is connecting Raleigh with a number of outside points. Over $50,000 will be expended.

GREENSBORO, N. C.—It is reported that the American Telephone and Telegraph Company, of Greensboro, has purchased the property and franchise of the Greensboro Telephone Exchange.

NEW BRUNSWICK, N. J.—A franchise granting rights to the Central New Jersey Telephone Company has been approved by the Council over the Mayor's veto. In the debate preceding the ballot it was charged that opponents of the franchise had offered financial inducements to men to vote against the franchise.

TRENTON, N. J.—The National District Telephone Company has been incorporated, capital $100,000. Incorporators: S. W. Slayer, James H. Reid, B. A. Judd, R. W. Beard.

CAMDEN, N. J.—The Camden & Atlantic Telephone Company has been incorporated, with a capital stock of $200,000, by Wilfred B. Wolcott, C. E. Wilson and Norman Gray.

TRENTON, N. J.—The Interstate Telephone Company is making preparations to extend its system throughout the northern part of the state. The company has applied for several municipal franchises and the work of building the lines between the various towns will soon be commenced.

CANNONVILLE, N. Y.—The Cannonville-Deposit Telephone Company has been incorporated with a capital stock of $900. W. G. Pomeror is one of the incorporators.

MANCHESTER, N. Y.—The Red Jacket Telephone Company, of Manchester, has been incorporated, with a capital stock of $500, by Carlos P. Osgood, John H. Pratt and Oliver S. Titus.

PAVILION, N. Y.—The Oatka Valley Telephone Company has been organized by the election of the following-named officers: President, J. C. Doty; vice-president, Fred Chilson; secretary, George Bernd.

LANCASTER, N. Y.—The Farmers' Telephone Company has been organized in this village. Following are the officers: President, George Beck; vice-president, E. R. Ives; secretary and treasurer, H. Brunck.

CLAYTON, N. Y.—The Thousand Islands Telephone Company, of Clayton, has been incorporated, with a capital stock of $2,800, the incorporators being Wm. H. Consant, Chas. A. Ellis and Geo. H. McKinley.

PERU, N. Y.—The Champlin Valley Telephone Company, of Peru, has been incorporated with a capital stock of $3,000. The directors are J. E. Sherman, G. A. Mason and R. W. Hoff.

ITHACA, N. Y.—The Caroline Telephone Company has filed articles of incorporation. It has a capital stock of $3,000, and will build lines to connect the principle villages in and near the town of Caroline. The directors are Omar D. Mulks, W. C. Gallagher, A. J. Slater, George M. Bull, C. R. Lounsberry, John L. Mandeville, Henry D. Thomas, George Peck, Benjamin Rightmyer, Charles H. Blood and C. D. Phillips.

IRONTON, OHIO.—The Ohio Valley Telephone Company has been organized, with a capital of $200,000, to consolidate the independent companies between Charlestown, W. Va., and Cincinnati. Extensions will be made.

ALTOONA, PA.—Johnstown and Pittsburg capitalists have organized a new telephone company, with a capital stock of $70,000, to build lines between Johnstown and Pittsburg. Construction work is already under way.

HUDSON, S. D.—The Hudson Telephone has been chartered and is about ready to start the construction of a system in this city. The company is capitalized at $10,000 and will build lines into the farming districts in all directions. At a recent meeting the following-named officers were elected: President, E. D. Cassill; vice-president, Oscar Oleson; secretary, Dr. E. R. Buck; treasurer, F. B. Cable.

GRANVILLE, TENN.—Dr. W. A. Hargis has organized a company to build a telephone line from Granville to Bagdad, Tenn., the line to be eventually extended in Kentucky.

NASHVILLE, TENN.—The Roaring Springs Telephone Company, of Greene County, Tenn., has been incorporated by H. A. Simpson and others, with $500 capital.

NORTH YAKIMA, WASH.—The Pacific States Telephone Company will make extensions and improvements in the local system.

GLENWOOD, WIS.—The West Wisconsin Telephone Company will build a line from Downing to Boyceville, with party lines for farmers en route.

CASCO, WIS.—The Casco & Brussels Telephone Company has increased its capital stock from $400 to $1,500.

FOND DU LAC, WIS.—The Wisconsin Telephone Company will build long distance lines to Plymouth.

STEVENS POINT, WIS.—A. W. Bryant, of Oshkosh, is forming a local company to establish a telephone exchange.

GLIDDEN, WIS.—The Glidden Telephone Company has been granted a franchise to build and operate a system in this town. The company will build several exchanges in Ashland County and a toll line. It consists of J. W. Hoops, George L. McCurdy, W. L. Schuppert and Bodway.

CAPON BRIDGE, W. VA.—The Capon Bridge Telephone Company has secured a charter to construct a telephone line from Romney, W. Va., to Gore, Va., and between other towns in Virginia and West Virginia. The capital stock is $10,000, and the incorporators are D. A. Daugherty, J. H. Orndoff, T. K. Oats, Edward Oats, T. F. Anderson.

ELECTRIC LIGHT AND POWER.

LOS ANGELES, CAL.—It is announced that the Pacific Electric Lighting & Power Company has acquired by purchase the San Bernardino Gas & Electric Company.

GRIFFIN, GA.—An election will be held at Griffin on June 10 on the question of issuing $100,000 bonds for sewerage, water and electric light improvements.

ATLANTA, GA.—The City Council of Atlanta has accepted the bid of the Georgia Electric Light Company for lighting the city for five years. The price is $75 a year for each arc light.

LEWISTON, IDA.—It is stated that this city will be provided in the near future with an electric power plant and electric light.

GREENSBURG, IND.—A ten-years' franchise has been granted the Greensburg Electric Company. The price is $69 per light on an all-night schedule. The present price is $75 per light on a moonlight schedule.

HUDSON, MASS.—The citizens have voted to appropriate $13,000 for an engine and generator for the municipal light plant.

AUGUSTA, ME.—The name of the Union River Light, Gas & Power Company has been changed to Bar Harbor & Union River Power Company.

OAKLAND, ME.—The Oakland Electric Company, of Oakland, has reorganized, increased its capital from $10,000 to $200,000, and purchased from the Messalonskee Electric Company its property in Oakland, including water power privileges. The purchasers will at once proceed with the development of the power. W. M. Ayer, of Oakland, and W. S. Wyman, of Waterville, are among the directors.

NORTH ADAM, MICH.—The citizens have voted for electric lights.

MT. CLEMENS, MICH.—Henry M. Wisler, of Chicago, Ill., and Chas. Flowers, of Detroit, have petitioned the Council for a heating and lighting plant.

STANDISH, MICH.—The citizens have voted to issue $20,000 bonds for water works and an electric light plant.

ST. CLOUD, MINN.—The Council has granted Mr. Carter a franchise for an electric light and power plant.

FARIBAULT, MINN.—It is reported that the Polar Star Electric Company will install a power plant at the Scott mill property and transmit power to this city. A new dam will be constructed.

BOZEMAN, MONT.—Alex. Freeman and other Bozeman parties have petitioned the county commissioners for an electric lighting franchise for the town of Belgrade.

ST. LOUIS, MO.—The Choctaw Gas, Light, Heat & Power Company has been incorporated; capital $150,000. Stockholders: Stanley D. Pearce, G. S. Hoss and Manton Davis.

LUMBERTON, N. C.—The citizens have voted for electric lights.

REGINA, N. W. TER.—It is proposed to construct an electric light plant, to cost $30,000. John Galt, of Toronto, Ont., is engineer.

TRENTON, N. J.—The Trenton Water Power Company is having plans prepared for a power plant.

ALBANY, ORE.—It is reported that the Canal & Water Company will expend about $20,000 in improvements to its electric light plant and system.

GALION, OHIO.—The Ohio Central Traction Company has entered the lighting field and is offering to furnish lighting and power in both Galion and Bucyrus.

BELLAIRE, OHIO.—The Bellaire Gas & Electric Company and the Bellmont Electric Light & Power Company have filed articles of consolidation, the name of the consolidated company being the Bellaire Light & Power Company. The company's capital is $150,000 and it will have its headquarters in Bellaire.

SHENANDOAH, PA.—The People's Electric Light, Heat & Power Comapny, of Shenandoah, has been incorporated with a capital stock of $20,000.

HARRISBURG, PA.—The following-named electric light companies, each with a capital stock of $10,000, have recently been incorporated: Haverford Township Electric Light Company; Radnor Township Light Company; the Upper Merion Electric Light Company; Newton Township Electric Light Company; Easttown Township Light Company; Easttown Township Electric Light Company; Willistown Township Electric Light Company; Tredyffrin Township Electric Light Company and the Radnor Township Electric Light Company.

MEMPHIS, TENN.—The petition of the Memphis Consolidated Gas & Electric Company has been granted to place underground conduits, at a cost of about $93,000.

FLORESVILLE, TEX.—The citizens voted to issue $18,000 bonds for constructing water works and an electric light plant.

BELTON, TEX.—C. H. Denny, C. W. Meyers and Thomas Fairweather have purchased the plant of Belton Light & Power Company, and will install a day circuit.

PORT ANGELES, WASH.—It is stated that the Council will install new machinery at the electric light plant.

NEW MARTINSVILLE, W. VA.—A charter has been granted to the Paden Valley Company, of Pittsburg, Pa., for the construction of water works and for carrying on operations to procure gas and electricity for supplying Paden Valley, in W. Va., with light, heat, power and water; capital $200,000. The plant is situated between New Martinsville and Sistersville. Incorporators: Thos. A. Watkins, Robt. Miller, and others, all of Pittsburg, Pa.

THE ELECTRIC RAILWAY.

LOS ANGELES, CAL.—Surveys have been completed for the new electric railway to be built immediately from Hueneme, Ventura County, to Bakersfield, a distance of 115 miles. Gervaise Purcell, engineer of the road, is in charge of purchasing construction material and equipment.

WASHINGTON, D. C.—A certificate of the incorporation of the United States Lighting & Traction Company of the District of Columbia, has been filed. The capital stock is $2,000,000 and the incorporators are Edward White, W. A. White, W. I. Francis, of Washington, D. C.; Herbert L. Stillman, of West Acton, Mass.; Thomas W. Bickwell, of Providence, R. I. The officers are Mr. Bickwell, president; Mr. Stillman, treasurer; Mr. Francis, secretary.

WASHINGTON, D. C.—John R. McLean and his associate have closed the deal for the purchase of the Great Falls & Old Dominion Electric Railroad. The announcement is made on authority that the company will build a line from the Virginia end of the Aqueduct Bridge to Great Falls. The following board of directors has been chosen to represent the new interests in control; John R. McLean, R. D. Weaver, R. H. Goldsborough, George G. Boteler, Nathan B. Scott, Colin H. Livingston and William F. Hart.

SPRINGFIELD, ILL.—At a meeting of the Springfield & St. Louis Railroad Company, action was taken towards building an electric railway from Springfield to St. Louis. H. H. Littell, of Buffalo, N. Y., resigned the presidency, and the directors elected Horace Riordan.

PLAINFIELD, IND.—The owners of the Indianapolis-Plainfield Railway are planning to extend the line to Green Castle this summer.

RICHMOND, IND.—The Eastern Indiana Traction Company and A. H. Lamar & Company, New York bankers, have closed a deal for the construction of 86 miles of trolley line between this city and Marion. Peter Schwab and ex-Governor Campbell of Ohio are interested.

MUSKOGEE, I. T.—John J. Geghan, of Cincinnati, Ohio, representing Ohio capitalists, has asked the Council of Muskogee for a franchise to build an electric railway system.

GARDNERVILLE, NEV.—It is stated that a company to be known as the Gardnerville & Carson Electric Railroad is to be organized to build an electric railway to connect Gardnerville and Carson.

PEPPERELL, MASS.—The Pepperell & Ayer Street Railway Company is to be organized to build an electric railway through Ayer, Groton, Pepperell and Dunstable to a point on the New Hampshire line, near Hollis. The length of the road will be 12 miles. The capital stock will be $120,000. William S. Murray, of Boston; Loring N. Farnum, of North Andover, and Everett E. Tarbell, of Pepperell, are interested.

NASHUA, N. H.—The Hudson, Litchfield & Goffs Falls Electric Railway which is to connect this city and Manchester, has organized as follows: John W. Center, George M. Reid, M. C. Griffin, Isaac N. Center, J. P. Newell, Arthur S. Campbell, George W. Clyde, Kimball Webster and P. J. Connell, directors; Isaac N. Center, of Manchester, president; Arthur S. Campbell, of Manchester, vice-president; John J. Baker, of Hudson. The directors were instructed to proceed immediately with the construction of the road.

CINCINNATI, OHIO.—The Cincinnati, Milford & Eastern Traction Company has completed plans and specifications for all the material that will be required for building and equipping the road and all contracts will be closed in the near future.

SPRINGFIELD, OHIO.—The Bushnell syndicate is planning the erection near Springfield of a large power station with which to operate the Springfield, Troy & Piqua line and the Springfield & Xenia line, recently acquired by the syndicate. The latter road has no power house of its own.

BOWLING GREEN, OHIO.—The directors of the Lake Erie, Bowling Green & Napoleon Railway Company have voted to increase the capital stock from $300,000 to $1,000,000. The additional capital will be used for the extension of the road from Pemberville to Port Clinton.

BEAVER FALLS, PA.—Charters have been taken out at Harrisburg for the Beaver Falls Electric Street Railway Company and the Beaver & Bridgewater Electric Railway Company. The capital stock and directors of both companies are the same. It is proposed to construct an electric railway connecting the boroughs of Beaver, Bridgewater and Beaver Falls. The officers are John H. Park, president; John Warren, of Beaver Falls; William Fisher, of Rochester; William A. Park, of Beaver; James M. Beal and John E. Park, of Beaver, directors.

PROVIDENCE, R. I.—The legislature has granted to Waldo A. Hopkins, Samuel Mellor, Nicholas S. Winsor and Alonzo P. Mowry a charter for an electric railway to be known as The Pascoag & Providence Street Railway Company, with power to construct an electric railway in Burrillville, Gloucester, Smithfield, Johnson and North Providence. The capital stock of the company is fixed at $700,000.

GREENVILLE, S. C.—The city of Greenville has granted a 50-year franchise to the Greenville & Anderson Electric Railway. Dr. J. E. Coughlin, of Indianapolis, Ind., is interested.

WATERTOWN, S. D.—The Watertown & Lake Kampeska Railway & Transportation Company, recently organized under the laws of the State of

South Dakota, with a capital of $100,000, is to construct an electric railway from Watertown to a point on Lake Kampeska, a distance of nearly four miles. The officers of the company are: M. R. Baskerville, president; W. R. Thomas, vice-president; H. J. Mowrey, secretary; H. L. Sheldon, treasurer.

MEMPHIS, TENN.—The Memphis Street Railway Company will make extensions to its lines involving an expenditure of about $175,000.

SMITHVILLE, TENN.—It is said that Messrs. Fecheimer and Keifer, of Cincinnati, and the Rothchilds Banking Company, of Cincinnati, are interested in a plan to build an electric railway between Smithville and Watertown. Water power could be developed at Cul-Carmac Falls, a distance of two miles from Smithville.

NASHVILLE, TENN.—The local and Kentucky and Pittsburg capitalists who have incorporated the Gallatin & Nashville Interurban Railway and the Nashville & Columbia Interurban Companies have decided to consolidate both in one corporation to be known as the Tennessee Interurban Railway. The road will have a length of 75 miles and will run through the richest and most populous territory of Tennessee. At present each company has a nominal capitalization of $50,000, but this will be increased to $3,000,000 and perhaps more. Surveys have been made and rights of way secured, but it will be impossible to get rails for the track until next fall.

PETERSBURG, VA.—The Virginia Passenger & Power Company is now installing a new 600-hp temporary addition to its plant in Petersburg.

PALOUSE, WASH.—A company composed of C. E. Frederick, J. K. McConack and G. W. Peddycord has asked the City Council for a twenty-five-year franchise to operate an electric railway in this city.

SPOKANE, WASH.—It is stated that a company is being organized for the purpose of constructing an electric railway between Spokane and Medical Lake, a distance of 18 miles.

ST. MARYS, W. VA.—The Williamstown & Moundsville Railway Company has been granted a fifty-year franchise to build an electric railway through the county. Guy A. Wagner, of Wheeling, is president of the company.

NEW MARTINSVILLE, W. VA.—The New Martinsville & Proctor Street Railway Company is being organized to build an electric railway here. Jacob Koontz, I. D. Morgan and D. H. Cox, of New Martinsville, are interested.

KEYSTONE, W. VA.—The Keystone Traction Company has been incorporated to construct an electric railway from Sand Lick to Maybury, McDowell County. The capital stock of the company is $25,000 and the incorporators are O. J. Evans, Benjamin Evans, John Evans, Northfork, W. Va.; M. Goldstein, D. E. French, Keystone.

MILWAUKEE, WIS.—It is stated that the Milwaukee Electric Railway & Light Company plans to extend its lines from Hales Corners to Mukonago.

MADISON, WIS.—The Milwaukee & Southern Railway Company, which will construct a railway from Milwaukee to East St. Louis, has organized by filing articles with the Secretary of State. The motive power to be used is not stated, but it is understood it will be an electric railway. The company is organized with $50,000 capital stock. The incorporators are Earl Parcells, Roy B. Tabor, Robert A. Peet, of Chicago, and John B. Wallace and Harry A. Porter, of Mukwonago, Wis. The line will be about 500 miles in length.

NEW INDUSTRIAL COMPANIES.

THE CHIPPEWA ELECTRIC COMPANY has been incorporated at Sault Ste Marie, Mich., with a capital stock of $5,000.

THE AUTOMOBILE MOTOR COMPANY has been incorporated at Syracuse, N. Y., to manufacture automobiles, motor cycles and automobile sundries.

THE COMMERCIAL MOTOR COMPANY, of Jersey City, has been incorporated with a capital of $250,000.

THE WIRELESS NEWS PUBLISHING COMPANY, of New York, has been incorporated with a capital of $5,000. Directors: James Stewart, H. E. Wise, and M. G. Lathrop, New York.

THE SUMTER TELEPHONE MANUFACTURING COMPANY, Sumter, S. C., is enlarging its plant to about twice the size of the present establishment.

THE MOTOR ENGINE CO., of New York, has been incorporated; capital, $150,000. Directors: F. J. Carolan, Burlingame, Cal.; H. T. Shriver and J. H. Brewster, Jr., New York.

THE NATIONAL CHEMICAL POWER COMPANY, with a capital of $25,000,000, has been incorporated in Arizona, to engage in the generation of electricity for power and lighting purposes by means of a chemical process.

THE NEW YORK SCHOOL OF TECHNOLOGY has been incorporated, capital $100,000. Directors: William Seaton and Charles Macy, New York; C. H. Ingalls, New Brighton.

THE PITTSBURG AND ALLEGHENY SUBWAY AND TUNNEL COMPANY, of Allegheny, Pa., has been incorporated to construct a tunnel between Pittsburg and Allegheny; capital $250,000.

THE ROYAL AUTOMOBILE COMPANY has been incorporated at Trenton, N. J., with a capital stock of $250,000. The incorporators are Louis B. Dailey, Warren B. Akers and K. K. McLaren.

THE NEW YORK LONG DISTANCE AUTOMOBILE COMPANY, of New York City, has been incorporated with a capital stock of $10,000. The directors are Lewis Nixon, W. M. McDougall and F. D. Hutchins.

THE TOBIAS MOTOR COMPANY, of Chicago, has been incorporated with a capital stock of $2,500, to manufacture engines, motors and machinery. The incorporators are John L. Tobias, Charles H. Ewing and Roy J. Zorn.

THE UNION SIGNAL COMPANY, of Sanford, Me., has been incorporated to manufacture and deal in electric car signals. The capital stock is $150,000. Mr. F. J. Allen, of Sanford, is president and treasurer.

THE OKLAHOMA ELECTRIC COMPANY, of Oklahoma City, Okla., has been incorporated with a capital of $1,000,000. The incorporators are F. B. Ziegler, William F. Young, B. R. Harrington, H. W. Boyd, J. S. Alexander, W. F. Harn and G. W. Spencer.

THE R. M. PATRICK ELECTRIC CONTRACTING COMPANY, of Syracuse, N. Y., has been incorporated with a capital stock of $50,000. Mr. R. M. Patrick is manager and Fred D. McIntosh, president. The company has already several large contracts on hand.

THE EASTERN CONSTRUCTION COMPANY, of Bangor, Me., has been incorporated, with a capital stock of $10,000, for the purpose of building and operating electric power and light plants. The officers are V. H. Foss, president; J. H. Green, treasurer, both of Bangor.

THE QUEEN CITY ELECTRICAL SUPPLY COMPANY is the title of a new concern just started business in Battle Creek, Mich. The new company will do all kinds of electrical work, motor repairing and carry a full line of electrical supplies. Captain George Perry is manager of the company.

THE GUARANTEE ELECTRIC COMPANY, of St. Louis, Mo., has filed articles of incorporation, with a capital stock of $6,000, full paid. The incorporators are C. J. Briner, F. E. Briner, L. T. Nolker, W. H. Nolker, J. P. Casy and Wm. Koeneman.

THE THOMAS REESE, JR., COMPANY, of New York, has been incorporated to carry on business as mechanical engineers. The capital is $150,000 and the directors are Thomas Reese, Jr., J. R. Reese and J. M. Weldon, of New York.

THE WHITLOW CORPORATION has been organized at New Bedford, Mass., to do a general electrical and mechanical business. The capital stock is $5,000. The officers are Samuel Whitlow, president; Obed N. Swift, treasurer, and Samuel Whitlow, 2d.

THE VEHICLE EQUIPMENT COMPANY, of Waverly, N. Y., has been incorporated to do a business of truckmen, hackmen, mechanical and electrical engineers and manufacturers and dealers in motive power; capital, $3,000,000. Directors: Martin Conboy, H. T. Mead, Leonard D. Baldwin, C. A. Greene and Henry Schoenherr, New York.

LEGAL.

SUIT ON TELEPHONE STOCK.—The Appellate Division of the New York Supreme Court has decided that John M. Mack has a cause of action against the Telephone, Telegraph & Cable Company of America in his suit to recover $100,000, which he paid in August, 1900, on an agreement by which Mr. Mack subscribed to 10,000 shares of stock in the company, of a par value of $50 each, contracting to pay the balance of $400,000 as the company might make calls on its stockholders. The decision reverses Justice Davy of the Supreme Court, who upheld the company's demurrer. In overruling the demurrers the Appellate Division says that if Mack's representations are true, he is entitled to the recission of his subscription agreement and the return of his $100,000, no matter whether the stock is or is not worth the amount he agreed to pay for it. He cannot, however, recover against the directors individually, since there nowhere appears in his complaint any allegation that the stock is worthless or of less value now than it would be were all the representations made to him true, and therefore those who made the representations cannot be held liable for them. Besides, if he recovers against the company, he cannot expect to get additional damages against the directors.

PERSONAL.

MR. J. C. BARCLAY will, it is understood, represent the Western Union Telegraph interests at the approaching telegraph conference in London.

MR. THOMAS J. JOHNSTON, who is well-known in New York City as a counsellor at law and expert in patent causes, has moved from 66 Broadway to 11 Pine St.

MR. FRANK J. SPRAGUE, E. E., has been recommended by the Committee of Science and Arts of the Franklin Institute for the award of the Elliott Cresson medal for his multiple unit system of electric traction.

MR. GEORGE G. WARD, vice-president and general manager of the Commercial Cable Company, accompanied by Mr. Albert Beck, the secretary, will attend the telegraph conference in London this month.

MR. ALFRED H. HOLBROOK, patent law practitioner, has removed his law office to the Bank of Commerce Building, 31 Nassau Street, New York City.

MR. G. W. SCOTT, the well-known consulting engineer of Chicago, announces the removal of his offices to 1301-2 Security Bldg., to take care of an increasing business.

MR. F. A. CROSELMIRE, of the firm of Croselmire & Acker, platinum refiners, sailed last week on a three months' business trip to Europe on the Hamburg liner *Deutschland*.

MR. CHARLES KIRCHHOFF, editor of the *Iron Age*, lectures this week before the Franklin Institute, Philadelphia, on "The Utilization of Blast Furnace Gases for Power Purposes." The date is May 14.

GEN. E. S. GREELEY, formerly a leader in the electrical supply trade and now a prominent bank president at New Haven, Conn., has just been elected president general of the National Society of Sons of the American Revolution.

MR. ARTHUR WARREN, head of the publication department of the Westinghouse interests, with present quarters in England, is on a visit to this country, arriving by *Kronprinz Wilhelm* last week. After a few days in New York City Mr. Warren proceeded to Pittsburg.

MR. JOHN McGEORGE has recently been appointed consulting engineer of the Wellman-Morgan Engineering Company. This position is one of importance and has been so since the combination of the Wellman-Seaver-Morgan Engineering Company and the Webster-Camp & Lane Company.

MR. J. L. PUTNAM, general manager of the Clark Automatic Telephone Switchboard Company, Providence, R. I., has returned from a Western trip. He reports a most satisfactory condition of business out there. He closed a number of contracts for the company, and states that the outlook for its business is most promising.

PROF. R. S. MILLER, formerly associate professor of mechanical engineering at Purdue University, has been elected to a similar position in the school of engineering at Colorado College, Colorado Springs. Mr. Henry C. Lamb, who for some years has been in the employ of Mr. W. S. Stratton in the Independence Mine, has been appointed instructor in shop practice.

MR. HUGO REISINGER, of New York City, the well-known importer of "Electra" carbons and other electrical specialties, has been appointed honorary commissioner to Europe of the Louisiana Purchase Exposition Company. Mr. Reisinger has for some time been acting on the Exposition's New York committee for the reception of distinguished foreigners arriving in that city from Europe.

MR. SHIRO YAMAZAKI, who after graduation in Japan as an electrical engineer, entered the Schenectady works, where he has just completed a two-years' course in practical work, will return to Japan after visiting some of the more important electrical generating plants in this country. He will make the journey via Europe and also visit the most important electrical centers in Great Britain and the Continent.

MR. T. A. EDISON is also a great man in Germany. The Berlin *Tageblatt* asked its readers: "Who are the most distinguished ten men alive to-day?" It received 1,000 answers. Tolstoi's name heads the list, with 502 votes; Mommsen comes next, with 496; then Marconi, with 445; Ibsen, with 425; Edison, with 368; Nansen, 270; Röntgen, 264; Mensel, the artist, 248; Prof. Koch, 228 and Emperor William II, 203 votes.

MR. WILLIAM H. NISBET, of Sydney, New South Wales, formerly superintendent of locomotive power of the Queensland Government railways, who received his early training in the Westinghouse shops, and who now represents the Westinghouse Air Brake interests in Australia, sails from San Francisco this week, after a short visit to the United States. Some important contracts for electrical equipment, etc., are expected to be received on this side shortly after Mr. Nesbit's arrival in Australia.

MR. J. F. CALDERWOOD.—The directors of the Brooklyn Rapid Transit Company have decided to add a third vice-president to the list of officers and have elected J. F. Calderwood to the place. President Winter has also appointed Mr. Calderwood general manager, thus making him the virtual working head of the system. A year or so ago Mr. Calderwood came from St. Paul as assistant to President Greatsinger. He had eighteen years' experience in railroad management in the West.

MR. ALBERT VON HOFFMAN, Milwaukee, Wis., who will be remembered by street railway men as the inventor of the Falk cast welded joint, has announced through the daily press that he has invented a single-phase system of electric railway. No details as to the new system are given, however. The advantages claimed for the new system are those which would be common to any successful sipgle phase electric railway system, namely, the elimination of rotary converter sub-stations, and the use of a high voltage on the trolley wire without the necessity of more than one trolley wire.

MR. EDWARD HUBER has withdrawn from the firm of McCrosky & Huber, of Cincinnati, manufacturers of adjustable reamers, with which he has been connected for the past three years. He has accepted a position as assistant superintendent in charge of the night force at the large electrical establishment of the Bullock Electric Mfg. Co., Cincinnati. Before entering the above firm Mr. Huber was for several years associated with the Bullock Company and the latter is to be congratulated on securing the services of so able a mechanic as Mr. Huber has long shown himself to be.

MR. RAY D. LILLIBRIDGE, the well-known publication and advertising manager, has outgrown his quarters recently taken at 170 Broadway, New York City, and to secure more room has taken the suite on the fourteenth floor occupied previously by the Standard Steel Car Company. He is already installed and very much at home.

MR. H. S. MEYER, chief designing engineer of the British Thomson-Houston Company, Rugby, England, is now on a visit to this country, and has been spending a few weeks at the General Electric Works, Schenectady. He is now in New York, and after attending the annual meeting of the American Institute of Electrical Engineers will sail for England on May 26.

SPENCER TRASK & CO., the well-known New York bankers, electrical financiers, etc., announce that they have admitted to the firm Mr. Eliphalet Nott Potter, of New York; that Mr. A. M. Fox, of Albany, will represent them in that city as resident partner; that a general power of attorney has been given to Mr. Carl G. Smedberg, and that the concern is moving this week to new quarters corner of William and Pine Streets.

MAJOR A. C. JOLY DE LOTBINIERE, R. E., the deputy chief engineer of the Mysore Government, is now in the United States with a view to placing contracts for additional equipment for the Cauvery Falls power transmission plant which furnishes power to operate the gold mines in the Kolar district, Mysore, India. The existing electrical equipment, which was furnished by the General Electric Company has a capacity of 4,000-hp. It is to be extended to 10,000-hp. The turbines are of Pelton type built by the Swiss firm of Escher Wyss & Co., of Zurich. The transmission line is 92 miles in length. It is the longest in the British Empire.

LT. COL. CUBILLO, director of the Spanish Arsenal at Trubia, is now in New York for the purpose of purchasing further American electrical equipment, machine tools, etc., for installation in the extension of the plant, which turns out the big guns for the Spanish army and navy. The Westinghouse interests, as chronicled in these pages at the time, secured recently a contract for considerable electrical machinery, and the Niles-Bement-Pond Company furnished some large gun lathes and other machine tools. Col. Cubillo is a guest at the Hotel Manhattan. He is accompanied on his visit to this country by Mr. W. S. Accles, the European representative of the Niles-Bement-Pond interests.

MR. G. MARCONI.—A cable dispatch from Rome of May 7 says: Signor Marconi was made a Roman citizen at the Capitol at noon to-day by Prince Colonna, the Mayor of Rome. In the afternoon Marconi delivered a lecture in the great hall of the Capitol before King Victor Emmanuel and a large audience on what he had done and what he hopes to do in wireless telegraphy. At the conclusion of the lecture the King shook hands with Marconi and called him a glory to Italy. The enthusiasm manifested at Marconi's reception surpassed that exhibited during the recent visits of King Edward and Emperor William. Signor Marconi attended the State dinner given at the Quirinal the other day in honor of Emperor William, and the Kaiser, after cordially complimenting him, invited him to visit him at Berlin.

DR. M. I. PUPIN had a brief article in the twentieth anniversary number of the *New York World,* in which he said: Hitherto electricity has largely been employed as a motive power. It has been solving our problems of transportation and communication. It is just entering upon a new field, that of manufacture. It has moved things; now it will make them. The energy of our water reservoirs, our coal and oil fields will be transformed into electrical energy in great central electrical works, and from there distributed to various manufacturing points. Already Niagara is being to some degree utilized in this manner. I expect to live to see the time when most chemicals used for commercial purposes will be manufactured by electrical power. The United States will always lead in the development of electrical power, because it has enormous water power, coal and oil fields. This will enable it to attain and maintain an overwhelming commercial supremacy. This is all-important, for to-day commerce rules the world. Society rests upon an economical basis. Militarism, formerly triumphant, has lost its prestige. The influence of this country has brought about a revolution and instead of struggling for gold braid and hollow titles, men have learned here that position and influence are due to actual work done.

MR. CHARLES T. YERKES arrived on the *Kronprinz Wilhelm* last week, and was enthusiastic about the progress being made on the system of underground transit in London. He said: "When I was over here last I told you that the Londoners had not been able to grasp the full import of the improvements being made in their transit system. They are getting accustomed to it now, and are beginning to realize what we are doing, and just how big the undertaking is. The work has progressed faster than any other work of equal scope ever undertaken in the British Isles. Our immense new power-house is the key to the whole situation. It covers four acres of ground, and has a water frontage of 1,100 feet. It will contain ten 7,500-horse-power engines, and there will be spare space to increase the power by 50 per cent. All the machinery will be installed by July, 1904. We have converted one old steam road five and one-half miles long into what is called a fourth-rail system. It is really what is called over here a third-rail system, but a fourth rail is used to take back the current without any loss. It is a surface surburban road from Ely to Harrow. The public has no access to the tracks, so that there is no danger of an accident from the charged rails. On this line we are testing controllers and motors and educating the men who are to make up the force of our entire system in London. It is a kind of preparatory or training school."

MR. A. RIEPPEL, Koeniglicher Baurat, of Nurnberg, Germany, the managing director of the Augsburg-Nurnberg Manufacturing Company., well known for many years as one of the largest and most successful builders of structural iron work, engines, cars, bridges, etc., in Europe, is now visiting this country for the first time. His works employ about 16,000 men and now have over 2,000 at work on the bridges, etc., of the new railroads being built by Germany in China. Their latest success has been with gas engines, both for gaseous and liquid fuel. They have long built these engines in smaller units up to 400-hp. and operated with petroleum, but for the use of waste gas as well as producer gases and in larger units, they have recently developed an entirely new design constituting the result of many years of extensive experience. The engine which is of the double acting cycle type, generally in tandem arrangement, is best adapted for the various purposes of modern power development up to the largest units required by municipal central stations and iron and steel works. Mr. Rieppel's visit to this country was made to interest the Allis-Chalmers Company in the manufacture of the products of his company, and by mutual agreement to enable each or either of them to get into closer touch with the requirements of the trade throughout the world. A contract has been entered into by the two companies giving the Allis-Chalmers Company the exclusive right to manufacture and sell the Nurnberg gas engine for this country and selling rights in many foreign countries, especially the Far East and South Africa. Details of this have already been given in these pages. The Augsburg Nurnberg Manufacturing Company under the direction of Mr. Rieppel, has made a phenomenal success with this new gas engine having within the past few months received orders for some 50,000-hp. throughout Germany and Spain chiefly for generating electric energy and for blast furnace and spinning mill work. One of these engines now being built is for an important spinning mill in Northern Germany where the engine will be operated by producer gas. Mr. Rieppel is now on a tour of inspection throughout this country after which he will visit the new and extensive works of the Allis-Chalmers Company at West Allis where these engines will be built.

Trade Notes.

THE MILWAUKEE COMMUTATOR COMPANY, Milwuakee, Wis., has filed notice of dissolution.

THE NORTH ELECTRIC COMPANY, of Cleveland, Ohio, has increased its capital stock from $200,000 to $250,000.

THE PITTSBURG STEAMSHIP CO., controlled by the U. S. Steel Corporation, has ordered a large Cross oil filter from the Burt Mfg. Co., Akron, Ohio, for use on one of its steamers.

THE VIVE MANUFACTURING COMPANY, of Chicago, has changed its name to Norstrom Lock-out Telephone & Manufacturing Company, and the capital stock has been increased from $2,500 to $6,000.

THE OHIO ELECTRICAL WORKS, Cleveland, Ohio, have placed on the market a line of efficient battery fan motors, with either wet or dry batteries. The sizes are from 5 to 12 inch fans. The motor with 9-inch fan takes only ¾ of an ampere at 7 volts and runs the fan at 1600-r.p.m. A new catalogue with discount sheet is now ready for mailing.

THE DU NOYER-CURRY ADVERTISING AGENCY, Utica, N. Y., announces that it is changing its offices in that city in order to provide for increased business which it has been able to secure through the strong and artistic advertising display it has been able to make for its customers. The agency has a number of well-known companies on its books, including one or two electrical concerns.

THE PRATT & WHITNEY COMPANY, Hartford and New York, has issued a calendar dated from May 1. It is in the form of a pad. Each day some extract from "The Letters of a Self-Made Merchant to His Son" is placed before the user of the calendar, and from the character of these quotations it is known as "The Wisdom Calendar." It affords excellent daily food for thought and guides for action.

MR. CHARLES J. BOGUE, 213 Centre Street, New York City, has recently issued a series of four bulletins relating to projectors and searchlights, photo engraving lamps, theatrical lamps for stage lighting effects and therapeutic apparatus. Each bulletin is completely illustrated with views of the various apparatus coming under the different heads, and the principal dimensions are given in connection with the illustrations.

TRAVELING ELECTRIC HOISTS.—Pawling & Harnischfeger, Milwaukee, Wis., manufacturers of traveling cranes, have just issued a handsomely illustrated bulletin showing a variety of traveling electric cranes. Large halftones show the utility of these hoists and in many instances the service to which these machines are applied is described. Mention is made of a few applications to which these hoists are already applied and a list of companies using these machines is given.

THE BOSSERT ELECTRICAL CONSTRUCTION COMPANY, Utica, N. Y., has been publishing a series of twelve bulletins during the past year. These bulletins are 7½x10½ and are neatly and attractively printed. A handsome green and gold cover with brass fasteners is provided for binding. The entire Bossert line is covered and illustrated, including switches, panel and distributing boards, outlet and switch boxes, Erickson insulators, conduit bushings and couplings, etc.

HUBBELL PULL SOCKET.—Mr. Harvey Hubbell, Bridgeport, Conn., manufacturer of the Hubbard pull socket, has issued a neat circular in which are pointed out the advantages and features of this well-known device. By means of a pendant chain a single light, or a cluster of lights, may be turned on or off by a pull on the chain—every other pull turning the lights on; the alternate pulls cutting them out. These circulars are being sent out to electrical jobbers throughout the country.

THE GREGORY ELECTRIC COMPANY, Chicago, announces that it has just bought the large manufacturing property at the corner of Sixteenth and Lincoln Streets, Chicago, where it will overhaul and repair the larger size dynamos and motors exclusively. The new plant covers the entire block and is equipped with electric power transmission and electric traveling cranes, and railway tracks run into the building. At this new location the Gregory Company is ideally situated for quick handling and quick shipments, either in car lots or less, being within a quarter of a mile of the freight depots of all railroads in that section. The general offices and sales department will remain, as heretofore, at 54 South Clinton Street.

CHLORIDE ACCUMULATORS.—The use of storage batteries for lighting private yachts is rapidly increasing to such an extent that practically every steam yacht of modern construction now includes a battery of Chloride accumulators in its equipment. The great advantage of a storage battery lies in the fact that it enables the lights to be used throughout the night while the machinery is shut down, thus avoiding the vibration from the running of a generator which is especially noticeable in a yacht while lying at anchor. The Electric Storage Battery Company has recently contracted for the installation of five yacht lighting plants on boats now under construction at Morris Heights, N. Y.

THE OTIS ELEVATOR COMPANY will relinquish its extensive suite of offices in the Empire Building, New York, although its lease has still some time to run, and move to the Whitehall Building facing Battery Park, because of the impossibility of procuring additional accommodations in the former building and of the absolute necessity for increased office facilities. That a concern possessing about 12,000 square feet of floor space for its executive and sales offices in the popular Empire Building should be compelled to move, notwithstanding the possession of an unexpired lease, simply to get more room, is an couraging prospect, since the status of the elevator industry is indicative of the condition of affairs in the building and real estate trades, and in fact of the condition of business in general.

THE CHICAGO FUSE WIRE & MFG. CO. has just issued its catalogue No. 14, a copy of which is before us. It advertises fuse wire, fuse strip and fuse links for electric lighting and power circuits, also fuse blocks and fuses for telephone and telegraph work, together with wire joints and sundry items. all of the company's manufacture. This list is neatly printed on green tinted paper with a gilt cover, and is a convenient size for an ordinary pigeon hole. The Chicago Fuse Wire & Mfg. Co. believes that its customers will find this list most comprehensive and convenient from which to order. The catalogue also gives considerable condensed information. The company now carries stocks at its three offices in Chicago, Buffalo and New York. A copy of the catalogue will be sent on request.

ELECTRIC FANS AND ACCESSORIES.—The Manhattan Electrical Supply Company, New York and Chicago, confines its catalogue, No. 15, just issued, entirely to descriptions and illustrations of electric fans and accessories handled by it. The list includes bracket, ceiling and desk fans of a great variety, for both alternating and direct current, the machines being of all the standard makes and designs. Each style is briefly described. All the information necessary to aid the purchaser in selecting goods is given. This catalogue is peculiarly valuable because it brings together under one cover illustrations and descriptions of all the standard fans on the market, and the purchaser is thus enabled to compare the different machines without the inconvenience of handling separate catalogues.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MAY 5, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

726,837. ELECTRICAL DISTRIBUTING SYSTEM; Leonard Andrews, Hastings, England. App. filed May 10, 1902. Comprises an alternating current generator, a conductor to be supplied thereby, a discriminating choking device and duplicate feeders including separate coils of said device.

726,846. INSULATOR FOR ELECTRIC WIRES; Joseph R. Bell, Peckville, Pa. App. filed June 28, 1902. The pin has a slot in the end in which the wire is deposited and a cap screws over the pin to confine the wire in the slot.

726,912. ELECTRIC LIGHT HANGER; John P. Hebendahl, Elizabeth, and Mass. App. filed April 18, 1902. Details.

726,860. ELECTRIC FURNACE; Joseph M. Carrere, New Brighton, N. Y. App. filed May 22, 1902. A rotary cylinder built of refractory bricks and having stationary heads between which it turns.

726,868. TROLLEY WHEEL; Fred B. Corey, Schenectady, N. Y. App. filed Aug. 21, 1902. A sheet metal wheel of steel, having a copper tread.

726,869. TROLLEY WHEEL; Fred B. Corey, Schenectady, N. Y. App. filed Aug. 21, 1902. A modification of the preceding patent.

726,912 ELECTRIC LIGHT HANGER; John P. Hebendahl, Elizabeth and John J. Gaffney, Newark, N. J. App. filed Nov. 26, 1901. Details.

726,917. TROLLEY WIRE FINDER; Thomas S. Herrick, Muncie, and John H. Bissett and Franz M. Merrick, Anderson, Ind. App. filed Aug. 23, 1902. Elongated spiral grooves each side of the wheel conduct a displaced wire to the grove in the wheel.

726,929. INCANDESCENT LAMP; John W. Howell, Newark, N. J. App. filed April 29, 1901. A high-voltage lamp having a filament composed of a number of independent treated sections, jointed near the stem on the end of a supporting wire of smaller heat-radiating capacity than the terminal.

726,935. REGULATION OF ALTERNATING CIRCUITS; Thomas J. Johnston, Brooklyn, N. Y. App. filed November 20, 1901. (See Current News and Notes.)

726,936. TRANSFORMER; Thomas J. Johnson, Brooklyn, N. Y. App. filed Nov. 1, 1902. The inclosing casing of an oil-transformer contains passages for the circulation of a cooling liquid.

726,944. MULTIPLE SIGNAL TRANSMITTER; Geo. E. King, Newton Highlands, Mass. App. filed April 25, 1900. The signal wheel contains segments at different radial distances from the center, which are arranged to co-operate with respective circuit closers to send different signals.

726,945. ELECTRICAL OUTLET BOX; Hubert Krantz, Brooklyn, N. Y. App. filed Feb. 26, 1902. The box is in two parts connected by a ball joint, permitting them to be adjusted to fit the surface of the wall in which it is placed.

726,952. MEANS FOR AVOIDING HUNTING OF ALTERNATE CURRENT MACHINERY; Henry C. Leake, Newcastle-upon-Tyne, England. App. filed April 9, 1901. The invention relates to parallel systems of distribution in which single or multiphase machinery is so arranged and operated that the potential difference across their terminals is maintained constant in effective value and periodicity. The object is the provision of means whereby the periodic fluctuation of the angular velocity of the rotating part is decreased and in so far as it does occur, made of practical unimportance.

726,963. MEANS FOR PREVENTING THE DISTURBANCE OF TELEPHONE-CIRCUITS; Carl Joseph August Michalke, Charlottenburg, Germany. App. filed June 27, 1898. (See page 834.)

726,964. CENTRAL-ENERGY TELEPHONE SYSTEM; Kempster B. Miller, Chicago, Ill. App. filed November 26, 1900. (See page 834.)

726,984. TELEPHONY; William E. Pembleton, Wittenberg, Wis. App. filed June 19, 1901. (See page 834.)

726,987. MOTOR CONTROLLER; William B. Potter, Schnectady, N. Y. App. filed August 2, 1899. (See Current News and Notes.)

726,994. HAND SETTING MECHANISM FOR CLOCKS; Theodor Schaffer, Hellerup, Denmark. App. filed Feb. 5, 1900. Details.

727,021. TROLLEY; Wm. S. Stockton, Philadelphia, Pa. App. filed March 13, 1902. A yoke pivoted upon the trolley pole with its upper ends diverging from points near the rim of the wheel and serving to deflect the wire into the wheel.

727,024. MANUFACTURE OF CAMPHIDON; Julius Tafel, Wurzburg, Germany. App. filed April 3, 1901. A process consisting in submitting an acid bath of imido-camphoric acid to electrolytic reduction.

727,025. ART OF PRODUCING HYDROXYLAMIN; Julius Tafel, Wurzburg, Germany. App. filed Feb. 24, 1902. Nitric acid is reduced by electrolytic action.

727,026. CAMPHIDIN AND METHOD OF PREPARING SAME; Julius Tafel, Wurzburg, Germany. App. filed April 3, 1901. A process consisting in submitting a solution of imido-camphoric acid in sulphuric acid in the cathode compartment of a cell to the action of current and then removing the greater portion of the sulphuric acid and treating the remainder with chloroform to separate the resultant camphidon, then supersaturating the remainder with an alkali to isolate the camphidin.

727,031. ELECTRIC CONDUCTOR OR CABLE; Francis Tremain, Highgate, Eng. App. filed April 24, 1902. Induction coils are placed at short distances along a cable and suitably protected, to reduce the effects of "capacity."

727,041. INDEX NEEDLE OR POINTER FOR ELECTRICAL MEASURING INSTRUMENTS; Edward Weston, Newark, N. J. App. filed May 7, 1902. The counterweight of the needle is made in one piece therewith and bent upon itself as required to accurately adjust the balance.

727,060. TELEGRAPH APPARATUS; John C. Barclay, New York, N. Y. App. filed Jan. 10, 1903. Consists of novel means for converting direct current into alternating current and for maintaining ground connections for the line during the operation of the transmitters.

727,064. CIRCUIT CLOSER; Walter J. Bell, Los Angeles, Cal. App. filed Jan. 2, 1903. An attachment for trolley wires whereby current delivered therefrom to switch operating magnets in the track can be controlled from the car.

727,068. COLLECTOR FOR ELECTRIC TRAMROADS OR RAILROADS; Andre Balzano, Munich, Germany. App. filed Dec. 23, 1902. The slot containing the conductor is filled with a mixture of vaseline and glycerine.

727,077. APPARATUS FOR LOCATING METALS, MINERALS, BURIED TREASURES, ETC., WITHOUT DIGGING; Fred H. Brown, Los Angeles, Cal. App. filed Feb. 28, 1902. A testing apparatus for measuring the resistance between two points on the surface of the earth.

727,089. PRINTING TELEGRAPH; Henry Casevitz, Paris, France. App. filed Oct. 10, 1901. The invention relates more particularly to the operation of a register comprising a series of disks connected together similar to the disks of a mechanical counter.

727,095. METHOD OF UTILIZING CALCIUM CARBIDE REFUSE AND PRODUCT THEREOF; Geo. E. Cox, Niagara Falls, N. Y. App. filed Sept. 3, 1902. The refuse is converted into an ingot by passing a suitable current through it.

727,101. OZONE GENERATOR; George L. Curtis, New York, N. Y. App. filed Jan. 17, 1903. An apparatus adapted to generate ozone while held in the hand and to deliver the same to the nostrils of the user.

727,117. REVERSIBLE GALVANIC BATTERY; Thomas A. Edison, Llewellyn Park, N. J. App. filed Oct. 3, 1902. (See Current News and Notes.)

727,124. MOTOR; Harliegh Gillette, Chicago, Ill. App. filed July 17, 1902. The motive power is generated by a gravity-acting weight which operates intermittently against a swinging object. Between operations the weight is raised by an electro-magnet, the circuit of which is controlled by the weight.

727,147. AUTOMATIC OPERATING MECHANISM FOR ELECTRIC RAILWAY SWITCHES; Gray W. Johnston, New York, N. Y. App. filed July 16, 1902. A magnet energized by the car throws a peculiarly constructed circuit changer to energize one or the other of two magnets acting upon the switch point.

727,182. ARMATURE WINDING APPARATUS; Fred P. McBerty, Warren, Ohio. App. filed July 7, 1902. The armature shaft is clamped in a yoke which is rotated while a wire guide directs the wire into the grooves of the armature.

727,206. ELECTRIC SWITCH; Vernon Royle, Paterson, N. J. App. filed March 4, 1902. Details.

727,227. ELECTRIC RAILWAY; Clendinen A. Thompson, New York, N. Y. App. filed Feb. 4, 1903. A hood for the third rail is fastened to the web of the rail, thus making it possible to apply the invention to existing third rails.

727,249. RESISTANCE PILE; Edgar H. Wise, Westmont, Pa. App. filed May 12, 1902. Alternately arranged disks of conducting and non-conducting material having inter-engaging slit-portions which bring a portion of one into the plane of another.

727,276. MOTOR VEHICLE; Thomas L. Boyle, Ogden, Utah. App. filed Nov. 14, 1902. Details of a plan for throwing the motor onto a short circuit to act as a brake.

727,315. THERMAL ELECTRIC FIRE ALARM; Thomas B. Duncan and Francis A. Duncan, Newberg, Ore. App. filed March 6, 1902. An expansion chamber actuates a circuit closer, the amount of expansion permitted before such actuation being used to determine the location of the fire.

727,325. TRANSMISSION AND RECEIPT OF SIGNALS; Reginald A. Fessenden, Allegheny, Pa. App. filed June 2, 1900. (See Current News and Notes.)

727,326. SELECTIVE SIGNALING BY ELECTROMAGNETIC WAVES; Reginald A. Fessenden, Manteo, N. C. App. filed Aug. 27, 1902. (See Current News and Notes.)

727,327. RECEIVER FOR ELECTROMAGNETIC WAVES; Reginald A. Fessenden, Pittsburg, Pa. App. filed Sept. 27, 1902. (See Current News and Notes.)

727,328. RECEIVER FOR SIGNALING; Reginald A. Fessenden, Fort Monroe, Va. App. filed December 29, 1902. (See Current News and Notes.)

727,329. SIGNALING BY ELECTROMAGNETIC WAVES; Reginald A. Fessenden, Pittsburg, Pa. App. filed March 14, 1903. (See Current News and Notes.)

727,330. SIGNALLING BY ELECTROMAGNETIC WAVES; Reginald A. Fessenden, Fort Monroe, Va. App. filed March 21, 1903. (See Current News and Notes.)

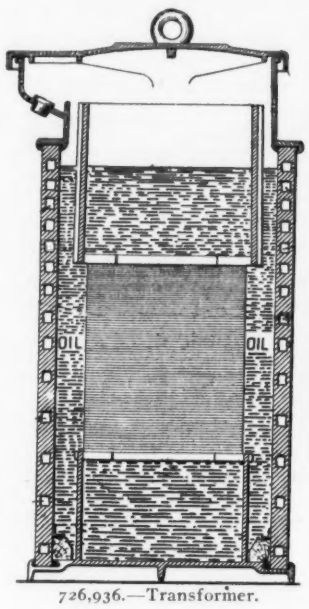
727,331. RECEIVER FOR ELECTROMAGNETIC WAVES; Reginald A. Fessenden, Pittsburg, Pa. App. filed April 9, 1903. (See Current News and Notes.)

727,360. ELECTRICAL WATER HEATER; Harry M. Hill, St. Louis, Mo. App. filed March 31, 1902. Two concentric cylinders forming the terminals of a circuit, the water being directed through an annular space between them and being heated by the passage of current through it.

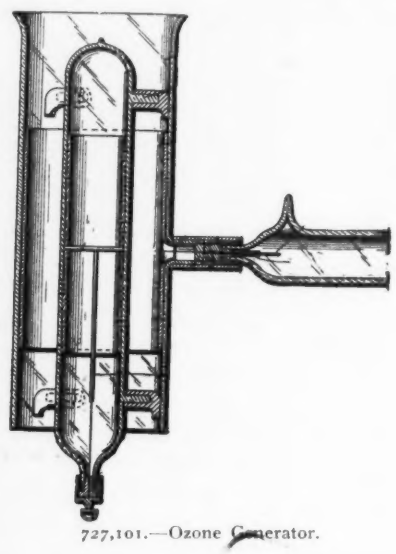
727,361. ELECTRICAL WATER HEATER; Harry M. Hill, St. Louis, Mo. App. filed May 10, 1902. A modification of the preceding patent.

727,411. ALTERNATING CURRENT MOTOR; Fred P. McBerty, Warren, Ohio. App. filed June 30, 1902. Small motors are started by twisting a crank shaft geared to the armature until such a speed is attained that the revolution is continued and accelerated by the current passing through.

727,457. APPARATUS FOR THE CONTINUOUS PRACTICE OF ELECTROLYTIC PROCESSES; Pedro G. Salom, Philadelphia, Pa. App. filed Sept. 17, 1902. The material to be acted upon is continuously supplied to an electrode and the product formed at another electrode is continuously removed without interruption of the process.



726,936.—Transformer.



727,101.—Ozone Generator.

727,468. ELECTRIC CURLING IRON; Murray Shepherd, Salt Lake City, Utah. App. filed April 29, 1902. The handle of the iron fits into the side of a lamp socket to receive current therefrom.

727,471. COMBINED ELECTROLYTIC AND MECHANICAL INTERRUPTER; Horace R. Smith, Altoona, Pa. App. filed July 25, 1902. An interrupter suitable for the operation of Ruhmkorff coils comprising both an electrolytic or Wehnelt interrupter of modified form and a mechanical interrupter mutually qualifying the effect of each other.

727,478. ELECTRIC SWITCH; John L. Steeb, Butler, Pa. App. filed Aug. 30, 1902. Details of an electro-magnetic railway switch.

727,496. PLATE FOR ELECTRIC ACCUMULATORS; Donato Tommasi, Paris, France. App. filed Aug. 3, 1901. Short bars or plates extend across the cavities containing the active material.

727,525. ELECTRIC BATTERY FOR BODY WEAR; Richard Wingren, Burlington, Kan. App. filed Feb. 16, 1903. Details.

727,543. MULTIPLE SIGNAL TRANSMITTER; George E. King, Newton, Mass. App. filed Dec. 11, 1902. A modification of patent No. 726,944.

727,549. CATHODE HOLDER; Joseph Matthews, Birmingham and William Davies, County of Worcester, England. App. filed March 29, 1901. The holder has a trough-like receptacle to receive the metal falling from the cathode.